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> "It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science in different parts of *Aṣia*, will commit their observations to writing, and send them to the Asiatic Society of Calcutta. It will languish, if such communications shall be long intermitted; and it will die away, if they shall entirely cease." SIR WM. JONES.

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JOURNAL

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ASIATIC SOCIETY OF BENGAL,

Vol. LXXI. Part II.—NATURAL SCIENCE.

No. I.—1902.

I.—*A List of the Butterflies of Hongkong in Southern China, and the food-plants of the larvæ.*—*By* LIONEL DE NICÉVILLE, F.E.S., C.M.Z.S., &c.

[Received 1st September; Read 6th November, 1901.]

The Butterflies of Southern China appear to have been largely neglected by modern Entomologists, though a considerable number of the larger species were known to the ancients. For instance, Linnæus and Fabricius described many species from "China," many of these and a few others were figured by Drury, Cramer, Herbst and Donovan at the end of the eighteenth century. In 1861 Wallengren described two new species and mentioned a third obtained during the voyage of the frigate "Eugénie" which touched at Hongkong; in 1862 Felder described four species and mentioned a fifth captured by the officers of the frigate "Novara" which visited the island; in 1886 Röber described two new species of *Lycænidæ* from Hongkong; while in 1899 Kirby recorded five species from thence. The first list of the butterflies known to occur in Hongkong was compiled by Messrs. Sydney B. J. Skertchly and James J. Walker, and is published in a little book entitled "Our Island. A Naturalist's Description of Hongkong" by Mr. Sydney B. J. Skertchly, F.G.S., M.A.I. (1893). This list embraces 116 species. Of these I have omitted from the present list *Ideopsis daos*, Boisduval, *Amathusia phidippus*, Doubleday, and *Pandita* sp., all of which are species found in the Malay Peninsula and are not likely to occur in Hongkong. But a much more important list is that by Mr. James J. Walker, R.N., F.L.S., entitled "A Preliminary List of the Butterflies of Hongkong; based on Observations and Captures made during the Winter and Spring months of 1892 and 1893," published in the Transactions of the Entomological Society of London for 1895, pp. 433–477. In this list 125 species are noted. In the present list I have omitted *Ideopsis daos* and *Amathusia phidippus* for the reason noted above. Moreover, Mr. Walker records what I consider to be five species under two names each, these being 8. *Euplœa* (*Isamia*) *superba*, Herbst, and 9. *Euplœa* (*Trepsichrois*) *midamus*, Linnæus. 16. *Ypthima hübneri*, Kirby, and 17. *Ypthima argus*, Butler. 78. *Catopsilia catilla*, Cramer, and 79. *Catopsilia crocale*, Cramer. 80. *Terias hecabe*, Linnæus, and 81. *Terias mandarina*, de l'Orza. 85. *Pieris* (*Huphina*) *nereisa*, Fabricius, and 86. *Pieris* (*Huphina*) *pallida*, Swinhoe. This reduces Walker's list to 118 species. In the present list 140 species are given, of which 22 marked with an asterisk (*) have not been seen by me. The gain in number of species observed in Hongkong in the six years since Walker wrote is therefore twenty-two. Walker also mentions a specimen of *Hestia lynceus*, Drury, which he had seen "taken more than twenty years ago on the wharf at Kowloon—an obvious importation." This species is omitted from his list and also the present one.

My friend, Mr. E. F. Skertchly, son of Mr. Sydney B. J. Skertchly in collaboration with Mr. Kershaw, proposes to bring out an elaborate work illustrated with coloured plates on the *Rhopalocera* of Hongkong. A specimen of these plates I have seen chromo-lithographed in Japan, and it is an excellent production. To help in the good work of publishing this volume I have written this paper, as entomological books are scarce in Hongkong, and my assistance has been asked as regards identification of the various species and the necessary synonomy. My share of this work appears in the list below; the particulars given of the food-plants of the same are closely-allied species occurring in India and elsewhere is a help to the discovery of the transformations of the various species of butterflies in Hongkong itself. A knowledge of the food-plant of any particular butterfly is more than half the battle in discovering its larva. I may note that Messrs. Skertchly and Kershaw have for the last few years sent me consignments from time to time of Hongkong butterflies for identification; moreover, I have a superficial knowledge of them from having twice visited the colony for short periods. The butterflies of Hongkong are on the whole remarkably similar to those of India, not a single genus being found in the island or on the adjoining mainland, which does not occur in India, while about ninety per cent. of the species are identical or extremely closely allied, the "local variation" being remarkably slight. This is perhaps not so much to be wondered at, as there is continuous land connection between India and Hongkong save the narrow strait about a mile wide which separates Kowloon or the mainland from the island. Moreover, Hongkong is on the same parallel of latitude as Calcutta, and has a very similar climate, though it is on the whole slightly cooler. The most interesting butterfly mentioned is, I think, *Danais* (*Anosia*) *erippus menippe*, Hübner, the well-known "Wanderer," a pair of which was taken in Hongkong in August last. This butterfly continues to extend its range, but has not as far as I know been yet obtained on the mainland of Asia, though it has spread from its original home in North America to Europe on the east, and right round through the Pacific Islands, Australia, and the Malayan Archipelago to the Straits of Malacca.*

Family NYMPHALIDÆ.

Sub-family DANAINÆ.

1. DANAIS (*Radena*), SIMILIS, Linnæus.

Papilio similis, Linnæus, Mus. Ulr., p. 299, n. 117 (1764); *Radena similis*, Moore, Proc. Zool. Soc. Lond., 1883, p. 223, n. 1; Lep. Ind., vol. i, p. 28 (1890); Fruhstorfer, Berl. Ent. Zeitsch., vol. xliv, p. 79 (1899); *Danais* (*Radena*) *similis*, Walker, Trans. Ent. Soc. Lond., p. 445, n. 5; *Danais similis*, var. *chinensis*, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii, n. 148 (1862); *Papilio aventina*, Cramer, Pap. Ex., vol. i, p. 92, pl. lix, fig. F (1775).

The larva of the subgenus *Radena* has two pairs only of fleshy filaments. Though species of *Radena* occur in Ceylon, Burma and the Nicobar Isles within Indian limits, the larva and its food-plant has escaped detection.

2. DANAIS (*Tirumala*) LIMNIACE, Cramer.

Papilio limniace, Cramer, Pap. Ex., vol. i, p. 92, pl. lix, figs. D, E, *male* (1775); *Tirumala limniace*, Moore, Proc. Zool. Soc. Lond., 1883, p. 230, n. 2; Lep. Ind., vol. i, p. 33 (1890); Fruhstorfer, Berl. Ent. Zeitsch., vol. xliv, p. 115; *Danais* (*Tirumala*) *limniace*, Walker, Trans. Ent. Soc. Lond., 1895, p. 445, n. 3.

The larva of *Tirumala*, like that of *Radena*, has two pairs only of fleshy filaments. It has been recorded in India to feed on many plants of the Natural Order *Asclepiadeæ*, such as *Calotropis*, *Asclepias*, *Marsdenia*, *Dregea* and *Hoya*.

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* *Vide* de Nicéville, Journal A. S. B., vol. lxiv, pt. 2, pp. 366-367 (1895).

3. DANAIS (*Tirumala*) SEPTENTRIONIS, Butler.

Danais septentrionis, Butler, Ent. Month. Mag., vol. xi, p. 163 (1874).

New to the Hongkong list; I have an undoubted female from there captured in March. The food-plant of the larva has never been discovered.

4. DANAIS (*Anosia*) ERIPPUS MENIPPE, Hübner.

Papilio erippus Cramer, Pap. Ex., vol. i, p. 4, pl. iii, figs. A, B, *male* (1775); *Anosia menippe*, Hübner, Verz. bek. Schmett., p. 16, n. 86 (1816); *Papilio plexippus* Cramer (*nec* Linnæus), Pap. Ex., vol. iii, p. 24, pl. ccvi, figs. E, F, *female* (1779); Herbst, Pap., vol. vii, p, 19, n. 8, pl. clvi, figs. 1, 2, *male* (1794).

A pair of this species was taken at Hongkong on the 4th August, 1901. The larva feeds on plants of the Natural Order *Asclepiadeæ*.

5. DANAIS (*Limnas*) CHRYSIPPUS, Linnæus.

Papilio chrysippus, Linnæus, Syst. Nat. Ins., ed. x., vol. i, pt. 2, p. 471, n. 81 (1758); *Limnas chrysippus*, Moore, Proc. Zool. Soc. Lond., 1883, p. 237, n. 1; *Danais* (*Limnas*) *chrysippus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 446, n. 7; *Limnas bowringi*, Moore, Proc. Zool. Soc. Lond., 1883, p. 239, n. 6; Fruhstorfer, Stet. Ent. Zeit., vol. lix, p. 412 (1898); *Limnas bowringii* [sic], Moore, Lep. Ind., vol. 1, p. 44 (1890).

Dr. F. Moore in 1893 recorded *L. chrysippus* from South China, but described *L. bowringi* as a new species from Hongkong, which also is in South China. In 1890, he says that it is "doubtfully of racial value." The larva of *Limnas* has three pairs of fleshy filaments; in Hongkong it has been reported to feed on *Asclepias curassavica*, Linn., and in India it feeds on plants of the Natural Order *Asclepiadeæ*, such as *Calotropis* and *Asclepias*.

6. DANAIS (*Salatura*) PLEXIPPUS, Linnæus.

Papilio plexippus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 471, n. 80 (1758); *Papilio genutia*, Cramer, Pap. Ex., vol. iii, p. 23, pl. ccvi, figs. C, D, *male* (1779); *Salatura genutia*, Moore, Proc. Zool. Soc. Lond., 1883, p. 240, n. 1; Lep. Ind., vol. i, p. 48 (1890); *Danais* (*Salatura*) *genutia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 445, n. 6.

The larva of *Salatura* has three pairs of fleshy filaments, and in India feeds on plants of the Natural Order *Asclepiadeæ*, such as *Cynanchum*, *Ceropegea* and *Passularia*, in Ceylon on *Raphis*, *Ceropegea* and *Raphanus*.

7. * DANAIS (*Parantica*) MELANOIDES, Moore.

Parantica melanoides, Moore, Proc. Zool. Soc. Lond., 1883, p. 847, n. 1; *Danais* (*Parantica*) *melanoides*, Walker, Tran Ent. Soc. Lond., 1895, p. 445, n. 4.

The larva of *Parantica* has two pairs only of fleshy filaments. The larva has never been discovered, but that of the allied species, *P. aglea*, Cramer, has been recorded to feed on plants of the natural order *Asclepiadeæ*, such as *Cryptolepis*, *Calotropis*, *Tylophora*, in South India and Ceylon.

8. DANAIS (*Caduga*) SITA, Kollar.

Danais sita, Kollar, Hugel's Kaschmir, vol. iv, pt. 5, p. 424, n. 1, pl. vi, figs. 1, 2, *male* (1844); *Danais* (*Caduga*) *sita* Mackinnon and de Nicéville, Journ. Bomb. Nat. Hist. Soc., vol. xi, p. 213, n. 6, pl. U, figs. 1*a*, 1*b*, *larva*; 1*c*, 1*d*, *pupa* (1897); *Danais* (*Caduga*) *tytia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 444, n. 2.

The larva of *Caduga* has two pairs only of fleshy filaments, and feeds in India on *Marsdenia*, natural order *Asclepiadeæ*. Hongkong specimens of *D. sita* agree absolutely with Indian ones.

9. EUPLŒA (*Crastia*) GODARTII, Lucas.

Euplœa godartii, Lucas, Rev. et Mag. Zool., second series, vol. v, p. 319 (1853); *Euplœa* (*Crastia*) *godarti* (sic), Walker, Trans. Ent. Soc. Lond., 1895, p. 447, n. 10.

The larva of *Crastia* has four pairs of fleshy filaments. Major (now Colonel) C. H. E. Adamson, C.I.E., in "Notes on the *Danainæ* of Burmah," p. 12 (1889), records that he has "bred *E. godartii* from caterpillars found feeding on orange trees," *Citrus* sp., natural order *Rutaceæ*. More probable plants would, I think, be species of *Holarrhena*, *Nerium* and *Ichnocarpus* of the natural order *Apocynaceæ*, or *Streblus* and *Ficus* of the *Urticaceæ*.

10. EUPLŒA (*Crastia*) KINBERGI, Wallengren.

Euplœa kinbergi, Wallengren, Wien, Ent. Monatsb., vol. iv, p. 35, n. 8 (1860); Kongl. Svensk. Fregatten Eugenies Resa, Zoologi, pt. v, p. 352, n. 4 (1861); *Tronga kinbergi*, Moore, Proc. Zool. Soc. Lond., 1883. p. 269, n. 12; *Crastia kinbergi*, de Nicéville, Journ. A. S. B., vol. lxx, pt. 2, pp. 20, 22 (1901), *Euplœa* (*Crastia*) *kinbergi*, de Nicéville, Journ. Bomb. Nat. Hist. Soc., vol. xiii, p. , n. , pl. , fig. , *female*; *Euplœa lorquinii*, Felder, Reise Novara, Lep., vol. ii, p. 340, n. 472 (1865); *Crastia lorquini* (sic), Moore, Lep. Ind., vol. i, page 91 (1890); *Euplœa felderi*, Butler, Proc. Zool. Soc. Lond., 1866, p. 275, n. 20; *Crastia felderi*, Moore, Lep. Ind., vol. i, p. 91 (1890); *Euplœa* (*Crastia*) *frauenfeldi* (sic), Walker (nec) Felder, Trans. Ent. Soc. Lond., 1895, p. 447, n. 11; *Crastia frauenfeldii*, Moore, Lep. Ind., vol. i, p. 87, pl. xxviii, figs. 1, 1*a*, *male* (1890).

This very variable and common butterfly is restricted to Southern China, and has been bred on *Strophanthus divergens*, Grah.—natural order *Apocynaceæ*. The larva will probably be found to feed on *Nerium*, natural order *Apocynaceæ*, or on *Ficus*, natural order *Urticaceæ*.

11. Euplœa (*Isamia*) midamus, Linnæus.

Papilio midamus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 470, n. 75 (1758); *Isamia midamus*, Moore, Proc. Zool. Soc. Lond., 1883, p. 312, n. 5, pl. xxxii, fig. 5, *male*; Lep. Ind., vol. i, p. 132 (1891); *Euplœa* (*Trepsichrois* [sic!]) *midamus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 446, n. 9; *Papilio superbus*, Herbst, Pap., vol. vi, p. 14, n. 3, pl. cxix, fig. 3, *female*; pl. cxx, figs. 1, 2, *male* (1793)*; *Euplœa superba*, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii, p. 488, n. 147 (1862); *Isamia superba* [sic], Moore, Proc. Zool. Soc. Lond., 1883, p. 311, n. 3; Lep. Ind., Vol. i. p. 132 (1891); Kirby in Hübner's Ex. Schmett., new edition, Vol. 1, p. 4, pl. xxiv, figs. 3, 4, *female* (*Limnas Mutabilis Midamus* [sic] on plate) (1894); *Euplœa* (*Isamia*) *superba* [sic], Walker, Trans. Ent. Soc. Lond., 1895, p. 446, n. 8; *Danais alopia*, Godart, Enc. Meth., vol. ix, p. 177, n. 4 (1819); *Isamia alopia*, Moore, Proc. Zool. Soc. Lond., 1883, p. 313, n. 6, pl. xxxii, fig. 7, *male*; Lep. Ind., vol. i, p. 132 (1891); *Isamia sinica*, Moore, Proc. Zool. Soc. Lond., 1883, p. 312, n. 4, Lep. Ind., vol. i, p. 132 (1891).

There are several mistakes in the references as usually given. Herbst calls his fig. 3 on pl. cxix a ♂, while it is a ♀, and his figs. 1 and 2 on pl. cxx a ♀, while it is a ♂. Dr. F. Moore sets this right in Proc. Zool. Soc. Lond., 1883, page 311, n. 3, as regards the ♀; but on page 313, n. 6, erroneously calls figs. 1 and 2 ♀ instead of ♂. He also uses *superba* instead of *superbus* as originally written, and refers to plate 102 instead of plate 122. He makes two species out of Herbst's figures, while they represent one species only.

Dr. F. Moore in 1883 and again in 1891 records and keeps distinct four species of *Isamia* from South China. These four species are in my opinion one and the same species, which at Hongkong, and doubtless wherever it occurs in Southern China, is a most variable one. In Hongkong the larva has been reported to feed on *Strophanthus divergens*, Grah., Natural Order *Apocynaceæ*.

Subfamily SATYRINÆ.

12. Mycalesis (*Calysisme*) mineus, Linnæus.

Papilio mineus Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 471, n. 84 (1758); *Calysisme mineus* Moore, Trans. Ent. Soc. Lond., 1880, p. 162; Lep. Ind., vol. i, p. 187 (1892); *Mycalesis mineus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 447, n. 13; *Mycalesis mineus*, var. *confucius*, Leech, Butt. China, Japan and Corea, p. 12, pl. ii, fig. 7, *male* (1892); Kirby, The Entomologist, vol. xxxii, p. 31 (1899).

The var. *confucius* is the dry-season form of *M. mineus* found in China. The larva in India feeds on grasses.

13. Mycalesis (*Calysisme*) horsfieldii, Moore.

Calysisme horsfieldii, Moore, Lep. Ind., vol., i, p. 197, pl. lxvi, figs. 2, 2*a*, 2*b*, *male, wet-season form; 2c, male, dry-season form* (1892); ? *Mycalesis perseus*, Wallace (*nec* Fabricius), Trans. Ent. Soc. Lond., 1895, p. 447, n. 12.

Only two species of *Mycalesis* have hitherto been found in Hongkong. Walker gives *mineus* and *perseus*. The latter is stated by Dr. F. Moore in Lep. Ind., vol. i, pp. 177, 178, to have a very wide range, being found almost throughout India, Ceylon, Burma, the Malay Peninsula and many of the islands of the Malay Archipelago, and in Hainan and Formosa. It may, as Walker states, be found in Hongkong, but it is more probable, I think, that what he identified as *M. perseus* is the comparatively common *M. horsfieldii*, which has been described since Mr. Walker wrote his paper. It has never been bred, but its larva will almost certainly be found on grasses.

14. LETHE EUROPA, Fabricius.

Papilio europa, Fabricius, Syst. Ent., p. 500, n. 247 (1775); *Lethe europa*, Walker, Trans. Ent. Soc. Lond., 1895, p. 448, n. 14; Moore, Lep. Ind., vol. i, p. 256 (1892).

The larva feeds on *Bambusa* Sp., natural order *Gramineæ*.

15. LETHE CONFUSA, Aurivillius.

Lethe confusa, Aurivillius, Ent. Tids., vol. xviii, p. 142, n. 15 (1897); ? *Lethe verma*, Walker, Trans. Ent. Soc. Lond., 1895, p. 448, n. 15; *Lethe rohria*, Kirby (*nec* Fabricius), The Entomologist, vol. xxxii, p. 31 (1899).

Mr. James J. Walker records *Lethe verma*, Kollar, from a single specimen taken in the Happy Valley, Hongkong, in March. This is, I think, probably an incorrect identification, the present species being meant. *L. verma* is a common species in the hills of Northern India, and is found in the hills of Western China, but not I believe in Western China. As the name implies, there has been much confusion regarding this species. Until recently it has been always known as *L. rohria* Fabricius, until Dr. Aurivillius pointed out that the true *rohria* is an older name for the *Lethe dyrta* of Felder. The larva will almost certainly be found to feed on the leaves of bamboo.

16. YPTHIMA AVANTA, Moore.

Ypthima avanta, Moore, Proc. Zool. Soc. Lond., 1874, p. 567; Elwes and Edwards, Trans. Ent. Soc. Lond., 1893, p. 33, n. 38, pl. i, fig. 27, *clasp of male*; *Ypthima ordinata*, Butler, Proc. Zool. Soc. Lond., 1880, p. 148, pl. xv, fig. 3; *Ypthima hubneri*, Walker, Trans. Ent. Soc. Lond., 1895, p. 448, n. 16; ? *Ypthima argus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 448, n. 17.

T. avanta is seasonally dimorphic, *avanta* is the dry-season form, while *ordinata* is the wet-season form. I have ventured to put Walker's two species *hübneri* [recte *huebneri*] and *argus* under *avanta*, as I do not believe that either of them are found in Hongkong, and that they have been wrongly identified. *T. avanta* is found in the Western Himalayas, in the plains of the North-Western Provinces, at Ranchi and Bholahat in Maldah, both in the plains of Bengal, in the Eastern Himalayas, in the Ganjam district of Eastern India, throughout Burma, and on the West River in Southern China.* It has not been bred, but the larva will be found on grasses.

17. MELANITIS ISMENE, Cramer.

Papilio ismene, Cramer, Pap. Ex., vol. i, p. 40, pl. xxvi, figs. A, B, *male, dry-season form* (1775); *Melanitis determinata*, Butler, Proc. Ent. Soc. Lond., 1885, p. vi, *Melanitis leda*, Walker, Trans. Ent. Soc. Lond., 1895, p. 449, n. 18.

This species in seasonally dimorphic, the dry-season form being *ismene*, the wet-season form is *determinata*. The larva feeds on rice, *Oryza sativa*, Linnæus, on large, coarse grasses, all of the natural order *Gramineæ*.

18.* MELANITIS BELA, Moore.

Melanitis bela, Moore, Horsfield and Moore, Cat. Lep. E.I.C., vol. i, p. 223, n. 465 (1857); *Cyllo aswa*, Moore, Proc. Zool. Soc. Lond., 1865, p. 769; *Melanitis aswa*, Walker, Trans. Ent. Soc. Lond., 1895, p. 449, n. 19.

This species is also seasonally dimorphic, *bela* being the wet-season form, *aswa* the dry-season form. Walker records one specimen taken at Kowloon late in 1891. I have not seen it from thence, but do not doubt the correctness of the record. It occurs in Western China, and as far westwards again as Kashmir. It has not been bred.

Subfamily AMATHUSIINÆ.

19. DISCOPHORA TULLIA, Cramer.

Papilio tullia, Cramer, Pap. Ex., vol. i, p. 127, pl. lxxxi, figs. A, B, *female* (1775); *Discophora tullia*, Staudinger, Ex. Schmett., p. 189, pl. lxiii, *female* (1887); Walker, Trans. Ent. Soc. Lond., 1895, p. 449, n. 20; Moore, Lep. Ind., vol. ii, p. 197 (1895); Fruhstorfer, Berl. Ent. Zeitsch., vol. xlv, p. 13 (1900).

As far as is known, the larvæ of all the species of this genus feed on *Bambusa* sp., Natural Order *Gramineæ*, and are gregarious, very hairy, and are frequently mistaken for the larvæ of moths.

20. CLEROME EUMEUS, Drury.

Danais Festivus eumeus, Drury, Ill. Ex. Ins., vol. i, p. 4, pl. ii, figs. 3, *male, upper—and underside* (1770); *Clerome eumeus*, Westwood, Trans. Ent. Soc. Lond., second series, vol. iv, p. 183, n. 2 (1858); Butler, Cat. Fab. Lep. B. M., p. 44, n. 1 (1869); Walker, Trans. Ent. Soc. Lond., 1895, p. 450, n. 21; Moore, Lep. Ind., vol. ii, p. 209 (1895); Kirby, The Entomologist, vol. xxxii, p. 31 (1899); *Papilio eumea* (sic), Cramer, Pap. Ex., vol. ii, p. 132, pl. clxxxiii, figs. C, D, *female* (1777); *Papilio gripus* Fabricius, Syst. Ent., App., p. 829, n. 178-79 (1775); Sp. Ins., vol. ii, p. 58, n. 255 (1781); Ent. Syst., vol. iii, pt. 1, p. 149, n. 457 (1793); Herbst, Pap., vol. vi, p. 77, n. 41, pl. cxxxv, figs. 3, 4, *female* (1793); *Satyrus gripus*, Godart, Enc. Meth., vol. ix, p. 497, n. 70 (1819); *Papilio grispus* (sic), Fabricius, Mant. Ins., vol. ii, p. 28, n. 294 (1787); *Papilio decempunctatus* Goeze, Ent. Beytr., vol. iii, pt. 1, p. 212, n. 31 (1779).

No species of *Clerome* has, I believe, ever been bred. The larva will almost certainly be found to feed on *Bambusa* sp., Natural Order *Gramineæ.*

It is remarkable that no species of the subfamily *Elymniinæ* has been recorded from Hongkong. As the importation of ornamental palms on which the larvæ feed is probably considerable from countries where species of the group are common, it is more than probable that species of *Elymniinæ* will become naturalised in the island and on the adjoining mainland.

Subfamily NYMPHALINÆ.

21.* CHARAXES (*Eulepis*) ATHAMAS, Drury.

Papilio Eques achivus athamas, Drury, Ill. Ex. Ins., vol. i, p. 5, pl. ii, figs. 4, *male, upper and underside* (1770); *Papilio athamas*, Cramer, Pap. Ex., vol. i, p. 140, pl. lxxxix, figs. C, D, *male* (1776); Walker, Trans. Ent. Soc. Lond., 1895, p. 458, n. 52; Moore, Lep. India., vol. ii, p. 254 (1895); *Eulepis athamas*, Rothschild and Jordan, Nov. Zool., vol. v, pl. x, figs. 1, 2, 3, 5, 7, 8, 9, 10, 11, *male*; 4, *female*; pl. xi, figs. 1, 2, 5, 6, 7, 10, 11, 12, *male*; 3, 4, 8, 9, *female* (1898); vol. vi, p. 245, n. 12 (1899).

Mr. James J. Walker records that he once saw this butterfly in Hongkong. Messrs Rothschild and Jordan under *b. E. athamas athamas* record it from South China (Hongkong), but add "Authentic Chinese specimens we have not examined." I have seen no specimen from Hongkong. The larva in Ceylon feeds on *Cæsalpinia*, Natural Order *Leguminosæ*; in South India on *Grewia* sp. Natural Order *Tiliaceæ*, on *Cæsalpinia*, *Painciana*, *Adenanthera*, *Acacia*, and *Albizzia*, Natural Order *Leguminosæ*; and in the Western Himalayas on *Acacia* and *Albizzia.*

22. CHARAXES POLYXENA POLYXENA, Cramer.

Papilio polyxena, Cramer, Pap. Ex., vol. i, p. 85 pl. liv, figs. A, B, *female* (1775); *Haridra polyxena*, Moore, Lep. Ind., vol., ii, p. 247 (1896); *Charaxes polyxena polyxena*, Rothschild and Jordan, Nov. Zool., vol. vii, p. 334 (1900); *Nymphalis polyxo*, Godart, Enc. Meth., vol. ix, p. 399, n 169 (1819); *Papilio bernardus*, Fabricius, Ent. Syst., vol. iii, pt. i, p. 71, n. 223 (1793); *Nymphalis (Charaxes) bernardus*, Donovan, Ins. China (Westwood's edition), p. 63, pl. xxxiv, figs. 1, 2, *female* (1842); *Charaxes bernardus*, Butler, Cat. Fab. Lep. B. M., p. 50, n. 2 (1869); Walker, Trans. Ent. Soc. Lond., 1895, p. 459, n. 53; *Haridra bernardus*, Moore, Lep. Ind., vol. ii, p. 246 (1896); *Dozocopa epilais*, Hubner, Verz. bek. Schmett., p. 50, n. 464 (1816).

My material from Hongkong can superficially be broken up into two distinct groups, one with pale tawny bands on the upper side of both wings, of which I have four males and one female, the males are dated 17th and 26th April, and 5th December, while one has no date; the female also bears no date: the other with white bands, of which I have two pairs, one male is dated 14th July, the other is undated; one female is dated 21st July, the other bears no date. *P. polyxena* was originally described from China, and my single tawny banded example of that sex agrees very well with Cramer's figure, but that the "tail" to the binding from the third median nervule is much longer (in Cramer's specimen it was probably broken off), and the dark and light markings of both wings on the underside are more strongly contrasted in Cramer's figure than in my specimen. The tawny banded males are extremely constant, and differ but little from my female; the "tail" to the hindwing is of course much shorter, and the submarginal series of black spots on the upperside of that wing instead of being each centred with a white spot has the anteriormost spot in one instance and the two anteriormost spots in three instances so marked. Of the white banded group in one male the band consists of four portions divided by the veins, the anterior the smallest, the posterior the largest, with a minute white spot anterior to the first of these with no spots beyond it whatever; in my other male the band consists of eight spots, there being two (instead of one as in the first-described specimen) in the upper discoidal interspace, and another in the subcortal interspace, as well as the one on the sutural area. The markings of the hindwing on the upperside also differ in my two male specimens, in the first described of these the discal band is fulvous, in the latter it is anteriorly white. My two white banded females also differ the one from the other, and neither of them agree with Donavon's figure, as that figure shows no discal band on the upperside of the hindwing, while in my specimens this band is prominent. In my two examples one has on the upperside of the forewing three fulvous-white spots anterior to the third median nervule, which are absent in the other. My specimens agree fairly well with Dr. Moore's description of that sex under the name of *H. bernardus*. Mr. J. O. Westwood remarked on Donovan's figures that "This uncommonly rare Chinese butterfly has not been figured in any other work. Fabricius described it only from the drawings of Jones. I possess a specimen in which the central fascia is nearly white, and is continued half way across the posterior wings, and the black spots in the latter are very broad and confluent, without white in the centre." Dr. Moore separated *H. bernardus* from *H. polyxena*, and noted that "This species [*bernardus*] is distinct from *H. polyxena*, Cramer, and is allied to the Indian *H. jalinder*, Butler, and *H. hippanax*, Felder." Fabricius described the medial band across the forewing on the upperside in *P. bernardus* as "flava," which is yellow, while Dr. Moore calls it "bluish-white." Donovan's figure of *P. bernardus* shows this band white just tinged with yellow. Fabricius' description of *P. bernardus* evidently applies to Cramer's figure of *P. polyxena*. In describing the male of *H. bernardus* Dr. Moore says that the white band on the upperside of the forewing ends "At the lower [first] median veinlet." This is probably a slip for submedian nervure. Messrs. Rothschild and Jordon give seven local races of *Charaxes polyxena*, of which the Chinese form "*G. polyxena polyxena*" is the last. They consider the white and yellow banded forms to be one and the same species, the species being dichromatic. It has never been bred.

23. APATURA (*Rohana*) PARYSATIS, Westwood.

Apatura parisatis, Westwood, Gen. Diurn. Lep., vol. ii, p. 305, n. 20, *note* (1850); *A. parisatis*, Staudinger, Ex. Schmett., p. 156, pl. lv, *male* and *female* (1886); *Rohana parisatis*, Moore, Lep. Cey., vol. iii, p. 17, pl. cxciv, figs. 2, 2*a*, *male*; 2*b*, 2c, *female* (1896); *Apatura parysatis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 452, n. 27.

The larva of *A. parysatis* has been bred in Hongkong on (*hiatus in MS.*)

That of the allied *A. carniba*, Moore, feeds in Ceylon and South India on *Celtis*, Natural Order *Urticaceæ*.

24. PARHESTINA ASSIMILIS, Linnæus.

Papilio assimilis, Linnæus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 479, n. 129 (1758); Mus. Ulr., p. 300, n. 118 (1764); Clerck's Icones Ins., vol. i, pl. xvi, fig. 1 (1759); Drury, Ill. Ex. Ins., vol. i, p. 33, pl. xvii, figs. 3, 4, *male* (1770); Cramer, Pap. Ex., vol. ii, p. 90, pl. cliv, fig. A, *female* (1777); Herbst, Pap., vol. vi, p. 43, n. 24, pl. cxxvi, figs. 4, 5, *male* (1793); Esper, Ausl. Schmett., p. 230, pl. lvii, fig. 1 (?1798); *Nymphalis assimilis*, Godart, Enc. Méth., vol. ix, p. 393, n. 151 (1819); *Hestina assimilis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 452, n. 28.

The larva of this species feeds in Hongkong on (*hiatus in MS.*)

25. PARHESTINA MENA, Moore.

Hestina mena, Moore, Ann. and Mag. of Nat. Hist., third series, vol. i, p. 48, n. 3 (1858); Leech, Butt. from China, Japan, and Corea, vol. i, p. 143, pl. xx, figs. 3, 4 *male* (1892); Walker, Trans. Ent. Soc. Lond., 1895, p. 452, n. 29; *Diadema* *mena*, Butler, Ann. and Mag. of Nat. Hist., vol. xvi, p. 398, n. 3 (1865); *Parhestina mena*, Moore, Lep. Ind., vol. iii, p. 36, pl. ccii, figs. 1, 1a, *female* (1896); *Hestina nigrivena*, Leech, The Ent., vol. xxiii, p. 31 (1890); Grose-Smith and Kirby, Rhop. Ex., pl. *Hestina* i, figs. 1, 2, *male* (1891); *Hestina viridis*, Leech, The Ent., vol. xxiii, p. 32 (1890).

Mr. Leech has himself sunk *H. viridis* to the rank of a variety of *H. mena*. From his figure of it (l.c., fig. 3) the underside of the hindwing has "the costa above the costal nervure and the abdominal fold yellow." Mr. Leech notes, however, that male specimens of var. *viridis* received subsequent to the description of the species have none of this yellow coloration. I am a little doubtful if this character is not sufficient to separate *H. viridis*, Leech, and *H. nicevillei*, Moore, from *P. assimilis*, Linnæus, and *P. mena*, Moore. *H. mena* was originally described from "North India," in 1895 Mr. Walker recorded it from Hongkong, but Dr. Moore in 1896 said the habitat is unknown. I have seen but a single pair from Hongkong, the female of which agrees very closely with Dr. Moore's figure of that sex (not a male as stated). I would draw especial attention to a series of four or five submarginal pink spots on both surfaces of the hindwing which are visible in my specimens, in Messrs. Grose-Smith and Kirby's figures and in Mr. Leech's figure No. 4 of var. *nigrivena*. These spots occupy the same position exactly as the crimson spots in *P. assimilis*, which has led me to suspect that *P. mena* is not improbably a dimorphic form of that species. The genus *Parhestina* is evidently in a very plastic state, and it appears to me that the process of mimicry to species of *Danais* is now actively going on. Typical *P. assimilis* with its brilliant crimson spots is a conspicuous species, and it is evident that it would be advantageous to it to become less gaudily coloured and to be able to pass itself off as a nauseous *Danais*. Mr. James J. Walker records the breeding of a specimen in Hongkong, but does not mention the foodplant of the larva, which still remains unknown.

26. EUTHALIA PHEMIUS, Doubleday and Hewitson.

Adolias phemius, Doubleday and Hewitson, Gen. Diurn. Lep., vol. ii, p. 291, n. 13 (1850); *Itanus phemius*, pl. xl, fig. 4, *male* (1850); id., Moore, Trans. Ent. Soc. Lond., new series, vol. v, p. 65, n. 4, pl. iii, fig. 3, *male* (*nec female*) (1859); *Euthalia phemius* Staudinger, Ex. Schmett., p. 153, pl. liv. *male* (*nec female*) (1886); Walker, Trans. Ent. Soc. Lond., 1895, p. 457, n. 47; Moore, Lep. Ind., vol. iii, p. 123, pl. ccxxxviii, figs. 1, 1*a*, *male*; 1*b*, 1*c*, *female* (1896); *Adolias sancara*, Moore, Horsfield and Moore, Cat. Lep. Mus. E.I.C., vol. i, p. 195, n. 394 (1857); Trans. Ent. Soc. Lond., new series, vol. v, p. 78, n. 34, pl. ix, fig. 1, *female* (1859).

Mr. James J. Walker having taken a pair coupled of this butterfly in Hongkong finally settles the question as to the opposite sexes of the insect. He also obtained a pupa attached to a twig under some litchi trees (*Nephelium Litchi*, Camb., Natural Order *Sapindaceæ*), but that cannot be the food-plant of the larva in India, as it grows wild nowhere in this country, while the butterfly is common in the Eastern Himalayas, Assam, Upper Burma, and Indo-China. Its food-plant still remains unknown.

27. LIMENITIS (Ladaga) CAMILLA, Linnæus.

Papilio camilla, Linnæus, Mus. Ulr., p. 304, n. 122 (1764); *Nymphalis camilla*, Aurivillius, Kongl. Svenska Vet.—Akad. Hand., vol. xix, n. 5, p. 101, n. 122 (1882); *Limenitis camilla*, Kirby in Allan's Nat. Hist., Butterflies, vol. i, pt. 1, p. 142, p. 145; *underside of normal imago, upper and underside of black variety*; pl. xxiii, fig. 3, *upperside of normal imago*; pl. iii, fig. 7, *larva* (1896); *Papilio prorsa*, Linnæus, Mus. Ulr., p. 303, n. 121 (1764), *nec Papilio prorsa*, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 480, n. 134 (1758); *Papilio sibilla*, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 781, n. 186 (1767); *Limenitis sibylla*, Leech, Butt. from China, Japan, and Corea, vol. i, p. 185 (1892); *Limenitis sidii*, var. *japanica*, Ménétriès, Cat. Lep. Pét., pt. 2, p. 103, n. 566 (1855); *Ladaga japonica*, Moore, Lep. Ind., vol. iii, p. 174 (1896).

This is a new record from Hongkong, though common in Japan, Corea, Amurland and Europe. Dr. Moore keeps the Japan form as a distinct species under the name *L. japanica*. Mr. Leech says that in Japan the larva feeds on *Lonicera japanica*, Thunberg, Natural Order *Caprifoliaceæ*. In England "The White Admiral" feeds also on honeysuckle.

28. ATHYMA SULPITIA, Cramer.

Papilio sulpitia, Cramer, Pap. Ex., vol. iii, p. 37, pl. ccxiv, figs. E, F (1779); Herbst, Pap., vol. ix., p. 95, n. 19, pl. ccxl, figs. 3, 4 (1798); *Athyma sulpitia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 456, n. 45; *Parathyma sulpitia*, Moore, Lep. Ind., vol. iii, p. 176 (1896). *Nymphalis strophia*, Godart, Enc. Meth., vol. ix, p. 431, n. 257 (1823).

The larva of this butterfly has never been found.

29. ATHYMA PERIUS, Linnæus.

Papilio perius, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 471, n. 79 (1758); *Athyma perius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 456, n. 43; Moore, Lep. Ind., vol. iii, p. 186 (1896); *Papilio leucothoë*, Linnæus, Syst. Nat., ed. x, p. 478, n. 122 (1758); *Limenitis leucothoë*, Donovan, Ins., China, new edition, p. 65, pl. xxxv, fig. 3 (1842); *Papilio polyxina*, Donovan, Ins., China, first edition, pl. xxxv, fig. 3 (1799).

The larva has been recorded to feed in Java on a species of *Phyllanthus*, Natural Order *Euphorbiaceæ*; in South India it feeds on two species of *Glochidion*, Natural Order *Euphorbiaceæ*.

30. Athyma asita, Moore.

A. asita, Moore, Proc. Zool. Soc. Lond., 1858, p. 13, n. 8; *Pantoporia asita*, Moore, Lep. Ind., vol. iii, p. cclxiii, figs. 2, *male*; 2*a*, *female* (1897); *Athyma nefte*, Walker (*nec* Cramer) Trans. Ent. Soc. Lond., 1895, p. 456, n 44.

This insect has never been bred.

31. Athyma selenophora, Kollar.

Limenitis selenophora, Kollar, Hügel's Kaschmir, vol. iv, pt. 2, p. 426, n. 1, pl. vii, figs. 1, 2, *male* (1844); *Athyma selenophora*, Walker, Trans. Ent. Soc. Lond., 1895, p. 457, n. 46; *Pantoporia selenophora*, Moore, Lep. Ind., vol. iii, p. 205 (1897); *Athyma bahula*, Moore, Proc. Zool. Soc. Lond., 1858, p. 12, n. 3, pl. i, fig. 2, *female*.

The larva in South India feeds on *Adina cordifolia*, Hook. f., Natural Order *Rubiaceæ*.

32.* Neptis antilope, Leech.

Neptis antilope, Leech, The Entomologist, vol. xxiii, p. 35 (1890); Butt. from China, Japan, and Corea, vol. i, p. 197, pl. xviii, fig. 2, *male* (1892).

Mr. Leech records having taken two specimens of this species at Hongkong in March, 1886. It has never been bred.

33. Neptis columella, Cramer.

Papilio columella, Cramer, Pap. Ex., vol. iv, p. 15, pl. ccxcvi, figs. A, B, *female* (1780); *Neptis columella*, Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 36; *Andrapana columella*, Moore, Lep. Ind., vol. iii, p. 220 (1897); *Neptis ophiana*, Moore, Proc. Zool. Soc. Lond., 1872, p. 561; *Neptis martabana*, Moore, Trans. Ent. Soc. Lond., 1881, p. 310; *Neptis ophiana*, var. *nilgirica*, Hampson, Journ. A.S.B., vol. lvii, pt. 2, p. 353, n. 57 (1888); *Andrapana columella singa*, Fruhstorfer, Berl. Ent. Zeitsch., vol. xliv, p. 286 (1899).

This butterfly has never been bred.

34. Neptis eurynome, Linnæus.

Papilio eurynome, (? *Papilio hylas*, male, *nec*. female), Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 486, n. 173 (1758); *Limenitis eurynome*, Westwood's ed. Donovan's Ins. China, p 66, pl. xxxv, fig. 4, *female* (1842); *Neptis eurynome*, Moore, Proc. Zool. Soc. Lond., 1874, p. 570; Lep. Ind., vol. iii, p. 244 (1897); Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 35; *Papilio leucothoë*, Clerck, Icones Ins., vol. iii, pl. v, fig. 4 (   ); Donovan, Ins. China, first edition, pl. xxxv, fig. 3, *female* (1799); *Papilio aceris*, Esper, Eur. Schmett., vol. i, pt. 2, pl. lxxxii, fig. 1, *female* (1783); *Neptis hainana*, Kirby (*nec* Moore), The Entomologist, vol. xxxii, p. 31 (1899).

The synonymy given above is mainly taken from Dr. Moore's Lep. Ind. Linnæus' Syst. Nat. Ins., tenth edition, is not available, so I am unable to check the first entry; though apparently the name given therein on p. 486, n. 173, is *hylas* and not *eurynome*. If this be so, *eurynome* cannot be ascribed to Linnæus, but should be credited to Westwood, as was done by Dr. Moore in 1874. Donovan's fig. 4 of pl. xxxv applies to this insect: he called it *leucothoë*, mistaking the insect for the *Athyma leucothoë* described by Linnæus as *Papilio leucothoë*, which itself is a synonym of the older Papilio [*Athyma*] *perius*, Linnæus. As there is an older *Neptis* named *leucothoë* of Cramer the species under consideration cannot be called *Neptis leucothoë*, Donovan. Mr. Kirby records *Neptis hainana*, Moore, originally described from Hainan Island, China, from Hongkong, but Dr. Moore considers that species to be distinct from the Hongkong one, so as I have no Hainan specimens I have followed him in this. This group of the genus occurs almost everywhere in the East, and in my opinion has received far too many names. Wherever the seasons are markedly wet and dry, seasonal dimorphism is very strongly marked, particularly so in Hongkong. The insect in Hongkong has not been bred, but the transformations of its Indian allies are well known, *N. varmana*, Moore, in South India being found in the larval state on peas of various kinds, Natural Order *Leguminosæ*.

35.* PRECIS ATLITES, Linnæus.

Papilio atlites, Linnæus, Cent. Ins., p. 24, n. 72 (Amoen., vol. vi. p. 407), (1763); *Junonia atlites*, Walker, Trans. Ent. Soc. Lond., 1895, p. 453, n. 31, Moore, Lep. Ind., vol. iv, p. 69 (1899).

The larva in Java feeds on a species of *Achyranthes*, Natural Order *Amarantaceæ*, and in South India on *Hygrophila* and *Barleria*, Natural Order *Acanthaceæ*.

36. PRECIS ORITHYA, Linnæus.

Papilio orithya, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 473, n. 94 (1758); Cramer, Pap. Ex., vol. i, p. 28, pl. xix, figs. C, D, *female*; pl. xxxii, figs. E, F, *male* (1775); *Cynthia orithya*, Westwood, Donovan's Ins., China, new edition, p. 64, pl. xxxv, fig. 2, *female* (1842); *Junonia orithya*, Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 34; Moore, Lep. Ind., vol. iv, p. 71 (1899); *Precis orithya*, Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. viii, p. 200, n. 12 (1901).

The larva has been recorded in the Himalayas to feed on *Antirrhinum Orontium* Linn., Natural Order *Scrophularineæ*; in South India on *Hygrophila*, Natural Order *Acanthaceæ*; and in Ceylon on acanthads.

37. PRECIS HIERTA, Fabricius.

Papilio hierta, Fabricius, Ent. Syst., Suppl., p. 424, n. 281-2 (1798); *Junonia hierta*, Moore, Lep. Ind., vol. iv, p. 75 (1899); *Papilio œnone*, Cramer (*nec* Linnæus), Pap. Ex., vol. i, p. 55, pl. xxxv, figs. A, B, *female* ; C, *male* (1775) ; *Cynthia œnone*, Westwood, Donovan's Ins. China, new edition, p. 66, pl. xxxvi, fig. 1, *male* (1842) ; *Junonia œnone*, Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 33 ; *Precis œnone* [*sic*], Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. viii, p. 203, n. 22 (1901).

The larva feeds in South India on *Hygrophila*, Natural Order *Acanthaceæ*, also on two plants of which the vernacular names are "Kolay Mooloo" and "Byle Choolee."

38. PRECIS LEMONIAS, Linnæus.

Papilio lemonias, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 473, n. 93 (1758) ; *Junonia lemonias*, Walker, Trans. Ent. Soc. Lond., 1895, p. 454, n. 32 ; Moore, Lep. Ind., vol. iv, p. 76 (1899) ; *Papilio aonis*, Cramer, Pap. Ex., vol. i, pp. 55, 56, pl. xxxv, figs. D, E, F, *male* (1775).

In India the larva feeds on *Nelsonia*, *Hygrophila*, *Strobilanthes* and *Barleria*, all Natural Order *Acanthaceæ*.

39. PRECIS ALMANA, Linnæus.

Papilio almana, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 472, n. 89 (1758) ; Cramer, Pap. Ex., vol. i, p. 90, pl. lviii, figs. F, G, (1775) ; *Cynthia almana*, Westwood, Donovan's Ins. China, new edition, p. 67, pl. xxxvi, fig. 2 (1842) ; *Junonia almana*, Moore, Lep. Ind., vol. iv, p. 79 (1899) ; *Papilio asterie*, Linnæus, Syst. Nat., ed. x, vol. i, p. 472, n. 90 (1758) ; Cramer, Pap. Ex., vol. i, p. 90, pl. lviii, figs. D, E (1775); *Junonia asterie*, Walker, Trans. Ent. Soc. Lond., 1895, p. 453, n. 30.

The larva in Java has been found feeding on *Justicia*, Natural Order *Acanthaceæ* ; in South India on *Hygrophila*, Natural Order *Acanthaceæ* ; in Calcutta on *Gloxinia* or *Osbeckia*, the latter Natural Order *Melastomaceæ*.

40. VANESSA CANACE, Johanssen.

Papilio canace, Johanssen, Amœn. Acad., vol. vi, p. 406, n. 68 (1764) ; Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. ii, p. 779, n. 173 (1767) ; *Vanessa canace*, Walker, Trans. Ent. Soc. Lond., 1895, p. 458, n. 50 ; *Papilio charonia*, Drury, Ill. Ex. Ent., vol. i, p. 28, pl. xv, figs. 1, 2, *female* (1770) ; Cramer, Pap. Ex., vol. i, pp. 73, 74, pl. xlvii, figs. A, B, C (1775) ; Herbst, Pap., vol. vii, p. 42, n. i, pl. xix, figs. 1, 2 (1794) ; *Vanessa charonia*, Godart, Enc. Méth., vol. ix, p. 308, n. 27 (1819) ; *Kaniska charonia*, Moore, Lep. Ind., vol. iv, p. 94 (1899) ; *Papilio kollina*, Meerburgh, Afb. Zeldz.-Gew., pl. xliii (1775).

Dr. Moore records this species as *Kaniska Charonia*, Drury, from Hongkong, but specimens from thence are identical with Indian examples of *V. canace*, Linnæus. Mr. James J. Walker has bred it in Hongkong on a species of *Smilax*, Natural Order *Liliaceæ*.

41. VANESSA INDICA, Herbst.

Papilio atalanta (part), Herbst, Pap., vol. vii, p. 171, n. 64, *Papilio atalanta* *indica*, pl. clxxx, figs. 1, 2 (1794); *Vanessa indica*, Walker, Trans. Ent. Soc. Lond., 1895, p. 485, n. 49; *Papilio atalanta* Cramer (*nec* Linnæus), Pap. Ex., vol. i, p. 132, pl. lxxxiv, figs. E, F (1775); *Hamadryas decora calliroë* Hübner, Samml. Ex. Schmett. (1806-16); *Pyrameis callirhoë* [*sic*], Moore, Horsfield and Moore, Cat. Lep. Mus. E. I. C., vol. i, p. 138, n. 879 (1857); *Vanessa vulcania*, Godart, Enc. Méth., vol. ix, p. 320, n. 55 (1819).

The larva of this butterfly in Ceylon feeds on *Urtica*, and in the Western Himalayas on different nettles of the Natural Order *Urticaceæ*.

42. VANESSA CARDUI, Linnæus.

Papilio cardui, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 475, n. 107 (1758); *Vanessa cardui*, Walker, Trans. Ent. Soc. Lond., 1895, p. 457, n. 48; Moore, Lep. Ind., vol. iii, p. 107 (1899).

The larva has been recorded in Ceylon to feed on *Artemisia*, Natural Order *Compositæ*; at Kandahar on different species of thistles; at Jutogh in the Western Himalayas on the common artichoke and on mallow; in the same region on nettles, but this is a doubtful food-plant, on thistles, on *Debregeasia*, Natural Order *Urticaceæ*, and on *Carduus*, Natural Order *Compositæ*; in South India on *Zornia*, Natural Order *Leguminosæ*, and on *Blumea*, Natural Order *Compositæ*; and at Lucknow on *Gnaphalium*, Natural Order *Compositæ*.

43. SYMBRENTEIA LUCINA, Cramer.

Papilio lucina, Cramer, Pap. Ex., vol. iv, p. 82, pl. cccxxx, figs. E, F, *female* (1780); *Symbrenthia lucina*, Moore Lep. Ind., vol. iv, pp. 113, 114 (1906); *Symbrenthia hyppoclus lucina*, Fruhstorfer, Berl. Ent. Zeitsch., vol. xlv, p. 20 (1900); *Symbrenthia khasiana*, Moore, Proc. Zool. Soc. Lond., 1874, p. 569; *Symbrenthia daruka*, Moore, Proc. Zool. Soc. Lond., 1874, p. 570, pl. lxvi, fig. 18, *male*; *Symbrenthia hyppoclus* [*sic*], Walker [*nec Cramer*], Trans. Ent. Soc. Lond., 1895, p. 458, n. 51.

In Sikkim the larva feeds on the stinging nettle *Girardinia* sp., in the Western Himalayas on nettles, *Debregeasia* sp., Natural Order *Urticaceæ*.

44. HYPOLIMNAS BOLINA, Linnæus.

Papilio bolina, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 479, n. 124 (1758); *Hypolimnas bolina*, Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 39; *Apatura bolina*, Moore, Lep. Ind., vol. iv, pp. 140, 144 (1900); *Papilio iacintha*, Drury, Ill. Ex. Ins., vol. ii, p. 36, pl. xxi, figs. 1, 2, *female*, (1773); *Nymphalis jacintha*, Westwood, Donovan's Ins. China, new edition, p. 68, pl. xxxvii, fig. 1, *female* (1842).

Mr. Gervose F. Mathew has found the larva of *H. bolina* feeding on *Sida rhombifolia* Linn., and *Sida retusa* Linn., Natural Order *Malvaceæ*, also upon a *Convolvulus*, Natural Order *Convolvulaceæ*, in the Australian region; in South India it feeds on *Portulaca*, Natural Order *Portulaceæ*, *Fleurya* and *Elatostema*, both Natural Order *Urticaceæ*; in

Central India it has been found on *Rostellulria*, Natural Order *Acanthaceæ.*

45*. HYPOLIMNAS MISIPPUS, Linnæus.

Papilio misippus, Linnæus, Mus. Ulr., p. 264, n. 83 (1764); *Hypolimnas misippus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 40; *Apatura misippus*, Moore, Lep. Ind., vol. iv, pp. 146, 150 (1900).

Mr. James J. Walker reports having seen a male of this species close to Kowloon in February. I have no other record of its occurrence in the colony. I do not know what form or forms of the female are found in China, three forms, *diocippus*, Cramer, *alcippoides*, Butler, and *inaria*, Cramer, are known from India. In India the larva feeds on *Portulaca*, Natural Order *Portulaceæ*. In Ceylon it feeds on *Abutilon* and *Abelmoschus*, Natural Order *Malvaceæ*.

46. CETHOSIA BIBLIS, Drury.

Papilio biblis, Drury, Ill. Ex. Ins., vol. i, p. 9, pl. iv, figs. 2, 2*a*, *male* (1770); Cramer, Pap. Ex., vol. ii, p. 120, pl. clxxv, figs. A, B, *male* (1777); *Cethosia biblis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 451, n. 26; Moore, Lep. Ind., vol. iv, pp. 185, 186 (1900).

The larva in Hongkong feeds on *Passiflora fœtida*, Linn., Natural Order *Passifloreæ*. In India it feeds also on passion-flowers.

47. ATELLA PHALANTHA, Drury.

Papilio phalantha, Drury, Ill. Ex. Ins., vol. i, p. 41, pl. xxi, figs. 1, 2 (1770); *Atella phalantha*, Moore, Lep. Ind., vol. iv, p. 198 (1900); *Atella phalanta* [*sic*], Walker, Trans. Ent. Soc. Lond., 1895, p. 451, n. 25; *Papilio columbina*, Cramer, Pap. Ex., vol. iii, p. 76, pl. ccxxxviii, figs. A, B (1779); vol. iv, p. 92, pl. ccexxxvii, figs. D, E (1781).

In Java the larva feeds on *Ixora*, Natural Order *Rubiaceæ*; in Ceylon and on *Flacourtia*, Natural Order *Bixineæ*; on *Salix*, Natural Order *Salicineæ*, in India and the Isle of Réunion off the coast of Africa on the former genus of plants.

48. CUPHA ERYMANTHIS, Drury.

Papilio erymanthis, Drury, Ill. Ex. Ins., vol. 1, p. 29, pl. xv, figs. 3, 4 (1770); Cramer, Pap. Ex., vol. iii, p. 77, ccxxxviii, figs. F, G (1779); *Argynnis erymanthis*, Westwood, Donovan's Ins. China, new edition, p. 64, pl. xxxv, fig. 1 (1842); *Cupha erymanthis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 451, n. 24; Fruhstorfer, Berl. Ent. Zeitsch., vol. xlii, p. 325 (1897); Stet. Ent. Zeit., vol. lx, p. 344 (1899); Moore, Lep. Ind., vol. iv, pp. 205, 206 (1900).

Mr. James J. Walker has bred the larva in Hongkong on *Glochidion eriocarpum*, Champ., Natural Order *Euphorbiaceæ*; in South India the larva has been found on a species of willow, and on *Flacourtia*, Natural Order *Bixineæ*.

49. CIRRHOCHROA MITHILA, Moore.

Cirrochroa mithila, Moore, Proc. Zool. Soc. Lond., 1872, p. 558; *Cirrhochroa mithila*, Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 38; *Cirrochroa rotundata*, Butler, Trans. Linn. Soc. Lond., Zoology, second series, vol. i, p. 543, n. 4 (1877).

This butterfly has never been bred.

50*. CIRRHOCHROA SATELLITA, Butler.

Cirrhochroa satellita, Butler, Cist. Ent., vol. i, p. 9 (1869); Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 37; *Cirrochroa satellita* [*sic*], Moore, Lep. Ind., vol. iv, p. 223 (1900).

The transformations of this butterfly are unknown.

51*. ARGYNNIS CHILDRENI, Gray.

Argynnis childreni, Gray, Zool. Misc., vol. i, p. 33 (1831); Walker, Trans. Ent. Soc. Lond., 1895, p. 456, n. 42; *Dryas childreni*, Moore, Lep. Ind., vol. iv, p. 229 (1900).

This fine butterfly has never been bred.

52. ARGYNNIS HYPERBIUS, Linnæus.

Papilio hyperbius, Linnæus, Cent. Ins., p. 25 (1763); *Papilio niphe*, Linnæus Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 785, n. 208 (1767); Drury, Ill. Ex. Ins., vol. i, p. 12, pl. vi, figs. 1, 1*a*, *female* (1770); Cramer, Pap. Ex., vol. i, p. 21, pl. xiv., figs. D, E, *male*; B, C, *female* (1775); *Argynnis niphe*, Walker, Trans. Ent. Soc. Lond., 1895, p. 455, n. 41; *Acidalia hyperbius*, Moore, Lep. Ind., vol. iv, pp. 234, 235 (1900); *Papilio argynnis*, Drury, Ill. Ex. Ins., vol. i, p. 13, pl. vi, figs. 2, 2*a*, *male* (1770).

The larva of this interesting butterfly feeds on violets and pansies, *Viola*, Natural Order *Violaceæ*.

53. ERGOLIS ARIADNE, Johanssen.

Papilio ariadne, Johanssen, Amœn. Acad., vol. vi, p. 407 (1764); *Ergolis ariadne*, Walker, Trans. Ent. Soc. Lond., 1895, p. 451, n. 23; Moore, Lep. Ind., vol. v, pp. 18, 19 (1901).

The larva in India feeds on *Tragia*, Natural Order *Euphorbiaceæ*.

Family RIODINIDÆ.

Subfamily NEMEOBIINÆ.

54. ZEMEROS FLEGYAS, Cramer.

Papilio flegyas, Cramer, Pap. Ex., vol. iii, p. 158, pl. cclxxx, figs. E, F, *male*

(1780); *Zemeros flegyas*, Walker, Trans. Ent. Soc. Lond., 1895, p. 459, n. 54; *Papilio allica*, Fabricius, Mant. Ins., vol. ii, p. 52, n. 510 (1787); *Zemeros phlegyas indicus*, Fruhstorfer, Berl. Ent. Zeitsch., vol. xlii, p. 333 (1897); *Zemeros confucius*, Kirby (*nec.* Moore), The Entomologist, vol. xxxii, p. 31 (1899).

Papilio flegyas was originally described from China, *i.e.*, Southern China, probably from the Canton region in which Hongkong is situated, as this is the region from which all the old writers received all the species from China which they described. Mr. Fruhstorfer doubts Cramer's locality and records *Z.* "*phlegyas*" from East and West Java only. He names the North Indian form *Z. phlegyas indicus*, but Indian specimens are identical with those from China. Mr. Kirby records *Z. confucius*, Moore, from Hongkong, a species originally described from the Island of Hainan off the coast of China. Whether this species is a good one or not I am unable to say, as I possess no butterflies from Hainan. Dr. Holland says that it is a good species. In India the larva feeds on *Mæsa*, Natural Order *Myrsineæ*.

55. ABISARA ECHERIUS, Stoll.

Papilio echerius, Stoll, Cramer's Pap. Ex., Suppl., vol. v, p. 140, pl. xxxi, figs. 1, 1A, *male*; 1B, *female* (1790); *Abisara echerius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 459, n. 55; *Papilio odin*, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 56, n. 175 (1793); *Lycæna xenodice*, Hübner, Verz. bek. Schmett., p. 23, n. 174 (1816).

I have not included in the synonymy given above the *Papilio coriolanus* of Fabricius, as it was described from "The Indies," and is said to have a common [on both wings] ferruginous band, which does not apply to the present species. Dr. Butler says it is well figured in the unpublished "Icones" of Mr. Jones, a book not available in Calcutta. The larva of the closely-allied *A. fraterna*, Moore, in Southern India on *Embelia* and *Ardisia*, Natural Order *Myrsineæ*; in Ceylon *A. prunosa*, Moore, feeds on *Ardisia* of the same Natural Order.

Family LYCÆNIDÆ.

56. GERYDUS CHINENSIS, Felder.

Miletus chinensis, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii, p. 488, n. 146 (1862); Reise Nov., Lep., vol. ii, p. 284, n. 364, pl. xxxv, figs. 35, 36, *female* (1865); *Gerydus chinensis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 460, n. 57.

The transformations of no species of *Gerydus* is known.

57. NEOPITHECOPS ZALMORA, Butler.

Pithecops zalmora, Butler, Cat. Fab. Lep. B. M., p. 161 (1869); *Neopithecops zalmora*, Walker, Trans. Ent. Soc. Lond., 1895, p. 460, n. 58.

The larva of this little butterfly feeds on *Glycosmis*, Natural Order *Rutaceæ* in South India.

58. CHILADES LAIUS, Cramer.

Papilio lajus, Cramer, Pap. Ex., vol. iv, p. 62, pl. cccxix, figs. D, E, *female* (1780); *Lycæna laius*, Butler, Cat. Fab. Lep. B. M., p. 171, n. 19 (1869); *Chilades laius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 461, n. 63; *Hesperia cajus*, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 296, n. 126 (1793); *Lycæna cajus*, Wallengren, Kongl. Svenska Fregatten Eugenies, Zoologi, pt. 1, p. 356, n. 12 (1861); *Plebeius leucofasciatus*, Röber, Iris, vol. i, p. 59, pl. iv, fig. 32, *male, wet-season form* (1886).

In India the larva feeds on *Citrus*, Natural Order *Rutaceæ*.

59. ZIZERA MAHA, Kollar.

Lycæna maha, Kollar, Hügel's Kaschmir, vol. iv, pt. 2, p. 422, n. 9 (1844); *Zizera maha*, Walker, Trans. Ent. Soc. Lond., 1895, p. 460, n. 60; *Lycæna bohemanni*, Wallengren, Wien, Ent. Monatsb., vol. iv, p. 37, n. 16 (1860); Kong. Svenska Fregatten Eugenies, Zoologi, pt. 1, p. 355, n. 11 (1861); *Lycæna argia*, Elwes, Proc. Zool. Soc. Lond., p. 888, 1881); *Plebeius albocæruleus*, Röber, Iris, vol. i, p. 59, pl. iv, fig. 7, *male* (1886).

Dr. A. G. Butler in Proc. Zool. Soc. Lond., 1900, p. 107, n. 3, pl. xi, figs. 5, 6, *male*, gives *Lycæna opalina*, Poujade, with *L. marginata*, Poujade, and *Plebeius albocæruleus* [*sic*], Röber, from Burma, Tibet and China as distinct from *Lycæna maha*, Kollar, with *Polyammatus chandala*, Moore, and *Zizera ossa*, Swinhoe, from Western India, occurring in the Lower Himalayas to Madras [? Bombay]; he also keeps distinct the *Lycæna diluta* of Felder, with *Lycæna squalida*, Butler, from the Eastern Himalayas southwards to Ganjam in the Madras Presidency. The latter species was originally described from Cachar, so the province of Assam must be added to the region of *Zizera diluta*. I am unable to follow Dr. Butler in his division of the wide-ranging *Z. maha* into three geographical races. No hard and fast geographical line can be drawn between them, *Z. maha* occurring from Kashmir at least (and probably still further to the west) on the west to Hongkong on the east. In Calcutta the larva feeds on *Oxalis*, Natural Order *Geraniaceæ*.

60. ZIZERA OTIS, Fabricius.

Papilio otis, Fabricius, Mant. Ins., vol. ii, p. 73, n. 689 (1787); *Lycæna serica*, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii. p. 487, n. 145 (1862); *Polyammatus sangra*, Moore, Proc. Zool. Soc. Lond., 1865, p. 772, pl. xli, fig. 8, *male*; *Zizera sangra*, Walker, Trans. Ent. Soc. Lond., 1895, p. 460, n. 59.

Dr. A. G. Butler in Proc. Zool. Soc. Lond., 1900, p. 111, retains *Lycæna indica*, Murray, described from Allahabad in the North-Western

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Provinces, but which Dr. Butler restricts to Central and South India and Ceylon, as distinct from *Papilio otis*. I have nothing to add to my note in Journ. A. S. B., vol. xlvi, pt. 2, p. 611 (1897) with regard to these two supposed distinct species. In Calcutta the larva feeds on *Alysicarpus*, Natural Order *Leguminosæ*; in South India on *Zornia*, Natural Order *Leguminosæ*.

61. EVERES ARGIADES, Pallas.

Papilio argiades, Pallas, Reise, vol. i, app., p. 472, n. 65 (1771); *Lycæna argiade* Walker, Trans. Ent. Soc. Lond., 1895, p. 461, n. 61.

The larva in South India feeds on *Cylista*, Natural Order *Leguminosæ*.

62. NACADUBA ATRATA, Horsfield.

Lycæna atratus, Horsfield, Cat. Lep. E. I. Co., p. 78, n. 13 (1828).

In Ceylon the larva feeds on *Vateria*, Natural Order *Dipterocarpeæ*; in South India on *Wagatea*, Natural Order *Leguminosæ*; and on *Embelia* and *ardisia*, both Natural Order *Myrsineæ*.

63. JAMIDES SIRAHA, Kheil.

Plebeius siraha, Kheil, Rhop. Nias., p. 30, n. 91, pl. v, fig. 35, *male* (1884); *J. bachus*, var., Distant, Rhop. Malay., p. 222, n. 1, pl. xxi, figs. 19, *male*; 16, *female* (1884).

The larva of this butterfly has never been found, but the allied *J. bachus*, Cramer, in South India feeds on *Butea*, *Pongamia* and *Xylia*, all of the Natural Order *Leguminosæ*.

64*. LAMPIDES CELENO, Cramer.

Papilio celeno, Cramer, Pap. Ex., vol. i, p. 51, pl. xxxi, figs. C, D, *male* (1775); *Hesperia ælianus*, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 280, n. 79 (1793); *Lampides ælianus* [*sic*], Walker, Trans. Ent. Soc. Lond., 1895, p. 461, n. 64.

In Java the larva feeds on *Butea*, Natural Order *Leguminosæ*; in Calcutta on *Heynea*, Natural Order *Meliaceæ*; and on *Pongamia*, Natural Order *Leguminosæ*; in South India on *Abrus*, *Pongamia* and *Saraca*, all Natural Order *Leguminosæ*.

65. CATOCHRYSOPS STRABO, Fabricius.

Hesperia strabo, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 287, n. 101 (1793); *Catachrysops* [*sic*] *strabo*, Walker, Trans. Ent. Soc. Lond., 1895, p. 462, n. 65.

The larva in Orissa feeds on *Dolichos*, Natural Order *Leguminosæ*; and in South India on *Schleichera*, Natural Order *Sapindaceæ*, and on *Ougeinia* and *Cylista*, Natural Order *Leguminosæ*.

66. CATOCHRYSOPS CNEJUS, Fabricius.

Hesperia cnejus, Fabricius, Ent. Syst., Suppl., p. 430, n. 100-101 (1798).

Dr. A. G. Butler in "The Entomologist," vol. xxxiii, p. 1 (1900), places *cnejus* in *Enchrysops*, which has the eyes smooth, and *strabo* in *Catochrysops*, as it has the eyes hairy. The larva in Calcutta feeds on *Phaseolus*, in Orissa on *Dolichos*, and in South India on *Ougeinia* and *Cylista*—all Natural Order *Leguminosæ*.

67. POLYOMMATUS BŒTICUS, Linnæus.

Papilio bœticus, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 789, n. 226 (1767); *Lycæna bætica*, Walker, Trans. Ent. Soc. Lond., 1895, p. 461, n. 62.

The larva in Calcutta feeds on *Crotalaria*; in South India on *Butea* and *Cajanus*; in Europe on *Colutea*; and in South Africa on *Crotalaria*; and in the Hawaiian Islands on *Melilotus*—all Natural Order *Leguminosæ.*

68. IRAOTA TIMOLEON, Stoll.

Papilio timoleon, Stoll, Suppl. Cramer, Pap. Ex., vol. v, p. 146, pl. xxxii, figs. 4, 4D, *female* (1790); *Deudorix (Iraota) timoleon*, Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 72; *Hesperia mæcenas*, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 271, n. 45 (1793); *Thecla mæcenas*, Westwood, Donovan's Ins. China, new edition, p. 70, pl. xxxix, fig. 2, *male* (1842); *Deudorix (Iraota) mæcenas*, Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 73.

The larva in South India feeds on three species of *Ficus*, Natural Order *Urticaceæ*; in Ceylon it feeds on the same plants.

69. CURETIS ACUTA, Moore.

Curetis acuta, Moore, Ann. and Mag. of Nat. Hist., fourth series, vol. xx, p. 50 (1877); Walker, Trans. Ent. Soc. Lond., 1895, p. 459, n. 56.

The larva of this butterfly has never been found, but closely-allied species in Calcutta feed on *Heynea*, Natural Order *Meliaceæ*, on *Pongamia* and *Derris*, Natural Order *Leguminosæ*; and in South India on *Abrus*, *Pongamia*, *Derris*, *Wagatea* and *Xylia*—all Natural Order *Leguminosæ*.

70. ILERDA PHŒNICOPARYPHUS, Holland.

Ilerda phœnicoparyphus, Holland, Trans. Amer. Ent. Soc., vol. xiv, p. 120, n. 52, pl. ii, fig. 1, *male* (1877).

This butterfly has never been bred.

71. CAMENA DEVA, Moore.

Amblypodia deva, Moore, Horsfield and Moore, Cat. Lep. Mus. E. I. C., vol. i, p. 46, n. 74 (1857).

The larva in India feeds on *Loranthus* Natural Order *Loranthaceæ*.

72. APHNÆUS LOHITA, Horsfield.

Amblypodia lohita, Horsfield, Cat. Lep. E. I. Co., p. 106, n. 38 (1829); *Aphnæus zebrinus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 462, n. 66.

In South India the larva feeds on *Zizyphus*, Natural Order *Rhamneæ*, *Wagatea* and *Xylia*, Natural Order *Leguminosæ*, *Terminalia*, Natural Order *Combretaceæ*, *Psidium*, Natural Order *Myrtaceæ*, *Lagerstræmia*, Natural Order *Lythraceæ*, *Argyreia*, Natural Order *Convolvulaceæ* and *Dioscorea*, Natural Order *Dioscoreaceæ*; and in Ceylon in plants of the Natural Order *Convolvulaceæ*.

73*. TAJURIA CIPPUS, Fabricius.

Hesperia cippus, Fabricius, Ent. Syst., Suppl., vol. v, p. 429, n. 43-44 (1798); *Tajuria longinus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 432, n. 67.

In Java and South India the larva of this butterfly feeds on *Loranthus*, Natural Order *Loranthaceæ*.

74. TAJURIA JANGALA, Horsfield.

Amblypodia jangala, Horsfield, Cat. Lep. E. I. Co., p. 113, n. 4 (1899); *Sithon jangala*, Walker, Trans. Ent. Soc. Lond., 1895, p. 462, n. 68.

This species has never been bred.

75. LEHERA ERYX, Linnæus.

Papilio eryx, Linnæus, Mant. Plant., p. 537 (1771); *Deudorix (Lehera) eryx*, Walker, Trans. Ent. Soc. Lond., 1895, p. 462, n. 69.

In British Bhutan in North-Eastern India the larva of this butterfly has been found feeding on the fruit of the wild pomegranate (? *Randia*) Natural Order *Rubiaceæ*).

76. DEUDORIX EPIJARBAS, Moore.

Dipsas epijarbas, Moore, Horsfield and Moore, Cat. Lep. Mus. E. I. Co., vol. i, p. 32, n. 40 (1857); Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 71.

The larva in the Western Himalayas feeds on the fruit of the pomegranate, *Punica Granatum*, Linn., Natural Order *Lythraceæ*, and on the fruit of the horse-chestnut, *Æsculus indica*, Colebr., Natural Order *Sapindaceæ*; in South India on the pods of *Connarus Ritchiei*, Hook. f., Natural Order *Connaraceæ*.

77. RAPALA SCHISTACEA, Moore.

Deudorix schistacea, Moore, Proc. Zool. Soc. Lond., 1879, p. 140.

In Calcutta the larva feeds on *Antidesma*, Natural Order *Euphor-*

biaceæ; in the Western Himalayas on *Spiræa*, Natural Order *Rosaceæ*; in South India on *Acacia*, Natural Order *Leguminosæ* and *Quisqualis*, Natural Order *Combretaceæ*.

78*. Rapala varuna, Horsfield.

Theela varuna, Horsfield, Cat. Lep. Mus. E. I. Co., p. 91, n. 24 (1829); *Deudorix orseis*, Hewitson, Ill. Diurn. Lep., p. 23, n. 20 (1863); *Deudorix* (*Rapala*) *orseis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 70.

The larva in South India feeds on *Zizyphus*, Natural Order *Rhamneæ*, *Xylia*, Natural Order *Leguminosæ* and *Quisqualis*, Natural Order *Combretaceæ*.

Family PAPILIONIDÆ.

Subfamily Pierinæ.

79. Delias hierte, Hübner.

Delias hierte, Hübner, Zutr. Ex. Schmett., figs. 77, 78, *male* (1818); Mitis, Iris, vol. vi, p. 107, n. 38 (1893); Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 75.

This species has never been bred, but the larva will almost certainly be found on *Loranthus*, Natural Order *Loranthaceæ*.

80. Delias aglaia, Linnæus.

Papilio aglaia, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 465, n. 44 (1758); *Delias aglaia*, Butler, Ann. and Mag. of Nat. Hist., sixth series, vol. xx, p. 162, n. 78 (1897); *Papilio pasithoë*, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 755, n. 53 (1767); *Pieris pasithoë*, Westwood, Donovan's Ins. China, new edition. p. 59, pl. xxx, figs. 2, 2*a*, *male* (1842); *Delias pasithoë*, Walker, Trans. Ent. Soc. Lond., 1895, p. 463, n. 74; *Papilio dione*, Drury, Ill. Ex. Ins., vol. ii, pl. viii, figs. 3, 4, *male* (1773); *Papilio porsenna*, Cramer, Pap. Ex., vol. i, p. 68, pl. xliii, figs. D, E, *male* (1775).

Larva probably feeds on *Loranthus*.

81. Catopsilia crocale, Cramer.

Papilio crocale, Cramer, Pap. Ex., vol. i, p. 87, pl. lv, figs. C, D, *female* (1775); *Catopsilia crocale*, Leech. Butt. from China, Japan, and Corea, p. 424 (1893); Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 79; *Papilio catilla*, Cramer, Pap. Ex., vol. iii, p. 63, pl. ccxxix, figs. D, E, *female* (1779); *Catopsilia catilla*, Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 78.[*]

The larva in India feeds on various species of *Cami*, Natural Order *Leguminosæ*.

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[*] Mr. James J. Walker keeps these two species distinct, and has reversed the references to them; moreover one of his dates is incorrect.

82. CATOPSILIA PYRANTHE, Linnæus.

Papilio pyranthe, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 469, n. 66 (1758); *Colias phyranthe*, Westwood, Donovan's Ins., China, new edition, p. 61, pl. xxxi, fig. 1, *male* (1842); *Papilio chryseis*, Drury, Ill. Ex. Ent., vol. i, p. 24, pl. xii, figs. 3, 4, *male* (1773); *Catopsilia chryseis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 77.

The larva of this butterfly in India feeds on *Cassia*, Natural Order *Leguminosæ*.

83*. TERIAS LIBYTHEA, Fabricius.

Papilio libythea, Fabricius, Ent. Syst., Suppl., vol. v, p. 427, n. 598, 599 (1798); *Terias libythea*, Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. i, p. 58, n. 3 (1898); *Terias brigitta*, Walker (*nec* Cramer), Trans. Ent. Soc. Lond., 1895, p. 465, n. 83.

In South India the larva of this butterfly feeds on *Cassia*, Natural Order *Leguminosæ*.

84*. TERIAS SUBFERVENS, Butler.

Terias subfervens, Butler, Ann. and Mag. of Nat. Hist., fifth series, vol. xi, p. 278 (1883); seventh series, vol. i, p. 65, n. 24 (1898); *Terias læta*, Walker (*nec* Boisduval), Trans. Ent. Soc. Lond., 1895, p. 465, n. 82.

This species has been bred in Japan on *Cassia*. Natural Order *Leguminosæ*.

85. TERIAS HECABE, Linnæus.

Papilio hecabe, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 470, n. 74 (1758); *Terias hecabe*, Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 80; Butler, Ann. and Mag. of Nat., Hist., seventh series, vol. i, p. 69, n. 36 (1898); *Terias anemone*, Felder, Wien. Ent. Monatsb., vol. vi, p. 23, n. 7 (1862); Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. i, p. 69, n. 36 (1898); *Terias mandarina*, de l'Orza, Cat. Lép. Jap., p. 18, n. 23 (1869); Walker, Trans. Ent. Soc. Lond., 1895, p. 465, n. 81.

Dr. A. G. Butler in his latest revision of the genus records both *T. anemone*, Felder, and *T. hecabe*, Linnæus, from Hongkong. Had he seen these common insects in life and noted the marvellous seasonal changes which takes place in them I do not think he would have wasted time in trying to make two distinct species out of them, each with wet-season, intergrade or intermediate, and dry-season forms. The larva in India has been recorded to feed on a great variety of plants of the Natural Order *Leguminosæ*, such as *Sesbania*, *Æschynomene*, *Cassia* and *Albizzia*.

86. DERCAS VERHUELLI, van der Hoeven.

Colias verhuelli, van der Hoeven, Tijdsch. voor Nat. Gesch. en Phys., vol. v,

p. 341, n. 3, pl. vii, figs. 3*a*, 3*b*, *female* (1839); *Dercas verhuelli*, de Nicéville, Ann. and Mag. of Nat. Hist, seventh series, vol. ii, p. 480, n. 1 (1898).

The larva and pupa of this species are unknown.

87. DERCAS SKERTCHLYI, de Nicéville.

Dercas skertchlyi, de Nicéville, Ann. and Mag. of Nat. Hist., seventh series, vol. ii, p. 481, n. 2 (1898).

The transformations of this genus are quite unknown.

88. IXIAS PYRENE, Linnæus.

Papilio pyrene, Linnæus, Mus. Ulr., p. 241, n. 60 (1764); *Ixias pyrene*, Walker, Trans. Ent. Soc. London, 1895, p. 467, n. 89; *Pieris (Thestias) pyrene*, Westwood, Donovan's Ins., China, new edition, p. 61, pl. xxxi, fig. 2, *male* (1842); *Papilio enippe*, Drury, Ill. Ex. Ins., vol. i, p. 11, and Index (two places), pl. v, figs. 2, 2*a*, *male* (1770); *Ixias evippe* (*sic !*), Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. i, p. 136, n. 11 (1898); *Papilio ænippe* (*ænippa* in one place in text), Cramer, Pap. Ex., vol. ii, p. 13, pl. cv, figs. C, D, *female* (1777); vol. iii, p. 63, pl. ccxxix, figs. B, C, *female* (1779).

The larva in India feeds on *Capparis*, Natural Order *Capparideæ*.

89. HEBOMOIA GLAUCIPPE, Linnæus.

Papilio glaucippe, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 469, n. 65 (1758); Drury, Ill. Ex. Ins., vol. i, p. 20, pl. x, figs. 3, 4, *male* (1773); *Hebomoia glaucippe*, Walker, Trans. Ent. Soc. Lond., 1895, p. 467, n. 90; Fritze, Zool. Jahr., vol. xi, p. 259 (1898); Fruhstorfer, Berl. Ent. Zeitsch., vol. xliii, p. 174 (1898); Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. i, p. 290, n. 1 (1898); *Pieris (Iphias) glaucippe*, Westwood, Donovan's Ins., China, new edition, p. 60, pl. xxxi, fig. 1, *male* (1842).

The larva of the allied *H. australis*, Butler, in South India feeds on *Cratæva* and *Capparis*, both of the Natural Order *Capparideæ*.

90*. PRIONERIS CLEMANTHE, Doubleday.

Pieris clemanthe, Doubleday, Ann. and Mag. of Nat. Hist., first series, vol. xvii, p. 23 (1846); *Prioneris clemanthe*, Walker, Trans. Ent. Soc. Lond., 1895, p. 464, n. 76.

The larvæ of allied species of this genus in India feed on *Capparis*. Natural Order *Capparideæ*.

91*. APPIAS ALBINA, Boisduval.

Pieris albina, Boisduval, Sp. Gen., vol. i, p. 480, n. 62 (1836); *Tachyris (appias) albina*, Walker, Trans. Ent. Soc. Lond., 1895, p. 467, n. 88.

The larva in South India feeds on *Hemicyclia*. Natural Order *Euphorbiaceæ*.

92. Huphina nerissa, Fabricius.

Papilio nerissa, Fabricius, Syst. Ent., p. 471, n. 123 (1775); *Pieris (Huphina) nerissa*, Walker, Trans. Ent. Soc. Lond., 1895, p. 466, n. 85; *Huphina nerissa*, Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. iii, p. 212, n. 53 (1899); *Papilio amasone*, Cramer, Pap. Ex., vol. 1, p. 68, pl. xliv, fig. A, *male* (1775); *Papilio coronis*, Cramer, Pap. Ex., vol. 1, p. 69, pl. xliv, figs. B, C, *female* (1775); *Huphina pallida*, Swinhoe, Proc. Zool. Soc. Lond., 1885, p. 137, n. 103; *Pieris (Huphina) pallida*, Walker, Trans. Ent. Soc. Lond., 1895, p. 466, n. 86.

The larva in India feeds on *Capparis*, Natural Order *Capparideæ*.

93*. Huphina aspasia, Stoll.

Papilio aspasia, Stoll, Suppl. Cramer, Pap. Ex., p. 148, pl. xxxiii, figs. 3, 3*c*, *male* (1790); *Pieris (Hupina) aspasia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 466, n. 87; *Huphina olga*, Butler, Ann. and Mag. of Nat. Hist., seventh series, vol. iii, p. 210, n. 43 (1899).

Mr. James J. Walker records a single specimen from Hongkong in the collection of the British Museum. True *H. aspasia*, Stoll, appears to be confined to the Moluccas, but the variety or local race, *Pontia olga*, Eschscholtz, is extremely common in the Philippines, and a specimen may easily have been blown over to Hongkong from thence in a typhoon. It has apparently not been bred, but like all *Huphinas* the larva probably feeds on capers, Natural Order *Capparideæ*.

94. Pieris canidia, Sparrman.

Papilio canidia, Sparrman, Amœn. Acad., vol. vii, p. 504, note *m* (1768); *Pieris canidia*, Leech, Butt. from China, Japan, and Corea, p. 456 (1893); *Pieris (Ganoris) canidia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 465, n. 84.

The larva of this butterfly, which is by far the commonest species in Hongkong, feeds on various species of *Brassica*, Natural Order *Cruciferæ*.

Subfamily PAPILIONINÆ.

95. Papilio aristolochiæ, Fabricius.

Papilio aristolochiæ, Fabricius, Syst. Ent., p. 443, n. 3 (1775); Rothschild, Nov. Zool., vol. ii, p. 245, n. 39 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 468, n. 91.

The larva in India feeds on *Aristolochia*, Natural Order *Aristolochiaceæ*.

96*. Papilio xuthus, Linnæus.

Papilio xuthus, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 751, n. 34 (1767); Walker, Trans. Ent. Soc. Lond., 1895, p. 472, n. 104; Rothschild, Nov. Zool., vol. ii, p. 503 (1895); *Papilio xanthus*, Rothschild, Nov. Zool., vol. ii, p. 278, n. 66 (1895).

In China and Japan the larva of this butterfly has been recorded to feed on *Zanthoxylum* and *Ægle*, Natural Order *Rutaceæ*, and on *Phellodendron*.

97. PAPILIO DEMOLEUS, Linnæus.

Papilio demoleus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 464, n. 35 (1758); Westwood, Donovan's Ins., China, new edition, p. 57, pl. xxviii, fig. 2, *female* (1842); Rothschild, Nov. Zool., vol. ii, p. 279, n. 67 (1895); *Papilio erithonius* Cramer, Pap. Ex., vol. iii, p. 67, pl. ccxxxii, figs. A, B, *male* (1782); Walker, Trans. Ent. Soc. Lond., 1895, p. 470, n. 98; *Papilio epius*, Westwood, Donovan's Ins., China, new edition, p. 56, pl. xxviii, fig. 1, *male* (1842).

The larva in India feeds on *Ruta*, *Glycosmis*, *Murraya*, *Citrus* and *Ægle*, all Natural Order *Rutaceæ*, *Psoralea*, Natural Order *Leguminosæ*, while the local race *P. demoleus sthenelus*, MacLeay, is said to feed on *Salvia*, Natural Order *Labiatæ*, New Guinea.

98. PAPILIO HELENUS, Linnæus.

Papilio helenus, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 459, n. 4 (1758); Elwes, Proc. Zool. Soc. Lond., 1881, p. 873; Rothschild, Nov. Zool., vol. ii, p. 284, n. 72 (1895); Walker, Trans. Ent. Soc. Lond., 1895, pl. 469, n. 96.

The larva in India feeds on *Zanthoxylum*, *Glycasmis* and *Citrus*, Natural Order *Rutaceæ*.

99. PAPILIO MEMNON AGENOR, Linnæus.

Papilio agenor, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 460, n. 13 (1758); Westwood, Donovan's Ins., China, new edition, p. 53, pl. xxiv, fig. 2, *female, second form* (1842); Walker, Trans. Ent. Soc. Lond., 1895, n. 469, n. 94; *Papilio memnon agenor*, Rothschild, Nov. Zool., vol. ii, p. 316 (d) (1895); *Papilio memnon*, Leech, Butt. from China, Japan and Corea, p. 544 (1893).

The larva of this butterfly does not appear to have been found in India, but it almost certainly feeds on plants of the arangeaceous group, Natural Order *Rutaceæ*. True *P. memnon*, Linnæus, in Sumatra feeds on *Citrus*.

100. PAPILIO PROTENOR, Cramer.

Papilio protenor, Cramer, Pap. Ex., vol. i, p. 77, pl. xlix, figs. A, B, *male* (1775); Westwood, Donovan's Ins., China, new edition, p. 56, pl. xxvii, *female* (1842); Elwes, Proc. Zool. Soc. Lond., 1881, p. 872, Leech, Butt. from China, Japan and Corea, p. 546 (1893); Rothschild, Nov. Zool., vol. ii, p. 331, n. 108 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 469, n. 95.

The larva of this butterfly in the Western Himalayas feeds on *Zanthoxylum*, Natural Order *Rutaceæ*.

101. PAPILIO POLYTES BOREALIS, Felder.

Papilio polytes, var. *borealis*, Felder, Wien. Ent. Monatsb., vol. vi, p. 62, n. 2 (1861); *P. polytes borealis*, Rothschild, Nov. Zool., vol. ii, p. 348 (*b*) (1895); *Papilio polytes*, Walker, Trans. Ent. Soc. Lond., 1895, p. 469, n. 97.

Mr. James J. Walker records the larva of this species in Hongkong feeding on orange, lime, and pumilo (*Citrus*, Natural Order *Rutaceæ*).

102. PAPILIO CLYTIA PANOPE, Linnæus.

Papilio panope, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 479, n. 131 (1758); *Papilio saturata*, Moore, Proc. Zool. Soc. Lond., 1878, p. 697; *Papilio clytia panope*, Linnæus, (g^2): ab. loe. *saturatus*, Rothschild, Nov. Zool., vol. ii, p. 369 (1895); *Papilio clytia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 470, n. 99.

In Hongkong the larva has been found on *Morinda umbellata*, Natural Order *Rubiaceæ;* in South India a local race of this species feeds in the larval state on *Cinnamomum*, *Alseodaphne* and *Litsæa*, Natural Order *Laurineæ;* in the Western Himalayas on *Litsæa;* in Calcutta on *Antiaris*, Natural Order *Urticaceæ;* and in Bombay on *Tetranthera*, Natural Order *Laurineæ;* the latter genus being apparently a synonym of *Litsæa*.

103. PAPILIO BIANOR, Cramer.

Papilio bianor, Cramer, Pap. Ex., vol. ii, p. 10, pl. ciii, fig. c (1777); Rothschild, Nov. Zool., vol. ii, p. 378, n. 142 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 468, n. 93.

The food-plant of the larva of this butterfly does not appear to have been recorded.

104. PAPILIO PARIS, Linnæus.

Papilio paris, Linnæus Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 459, n. 3 (1758); Westwood, Donovan's Ins., China, new edition, p. 51, pl. xxii, figs. 1, 2, *female* (1842); Walker, Trans. Ent. Soc. Lond., 1895, p. 468, n. 92.

The food-plant of the larva of this common butterfly is apparently unknown.

105. PAPILIO ANTIPHATES, Cramer.

Papilio antiphates, Cramer, Pap. Ex., vol. i, p. 113, pl. lxxii, figs. A, B, *male* (1775); Rothschild, Nov. Zool., vol. ii, p. 410, n. 170 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 471, n. 100.

I cannot find that the food-plant of this species has been recorded, though Mynheer Piepers has described the transformations of the local race *Alcibiades*, Fabricius, in Java.

106. PAPILIO EURYPYLUS AXION, Felder.

Papilio axion, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xiv, p. 305, n. 224, p. 350, n. 128 (1864); *Papilio eurypylus axion*, Rothschild, Nov. Zool., vol. ii, p. 433 (*b*) (1895); *Papilio eurypilus* [*sic!*], Walker, Trans. Ent. Soc. Lond., 1895, p. 471, n. 102.

The larva at Balasore near Calcutta has been recorded to feed on *Michelia*, Natural Order *Magnoliaceæ*, and *Uvaria*, Natural Order *Anonaceæ*. In Calcutta I have bred it on *Michelia*, Natural Order *Magnoliaceæ*, and on *Polyalthia*, Natural Order *Magnoliaceæ;* while the local race *yasan*, Esper, feeds on *Unona* and *Saccopetalum*, Natural Order *anonaceæ* in Southern India.

107. PAPILIO SARPEDON SEMIFASCIATUS, Honrath.

Papilio sarpedon, var. *semifasciatus*, Honrath, Ent. Nach., vol. xiv, p. 161 (1888); *Papilio sarpedon semifasciatus*, Rothschild, Nov. Zool., vol. ii, p. 442 (*b*) (1895); *Papilio sarpedon*, Walker, Trans. Ent. Soc. Lond., 1895, p. 471, n. 101.

The larva of different local races of *P. sarpedon* feed in Japan on *Machilus*, Natural Order *Laurineæ;* in the Western Himalayas on the same plant; and in South India on *Cinnamomum*, *Alseodaphne* and *Litsæa*, all of the same Natural Order.

108. PAPILIO AGAMEMNON, Linnæus.

Papilio agamemnon, Linnæus, Syst. Nat. Ins., ed. x, vol. i, pt. 2, p. 462, n. 21 (1758); Westwood, Donovan's Ins., China, new edition, p. 55, pl. xxvi, fig. 2, *female* (1842); Rothschild, Nov. Zool., vol. ii, p. 447, n. 198 (1895); Walker, Trans. Ent. Soc. Lond., 1895, p. 471, n. 101.

The larva of this butterfly in Java and Celebes has been found on *Anona*, Natural Order *Anonaceæ;* in the Philippine Isles on *Arctacarpus*, *Unona*, and *Michelia;* in Sumatra on *Anona* and *Michelia;* and in India on *Unona*, *Polyalthia*, *Anona*, and *Saccopetalum*—all Natural Order *Anonaceæ*.

109. LEPTOCIRCUS CURIUS, Fabricius.

Papilio curius, Fabricius, Mant. Ins., vol. ii, p. 9, n. 71 (1787); *Leptocircus curius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 472, n. 105.

In October, 1892, on the Daunat Range, Central Tenasserim, Burma, I observed a female of the allied *Leptocircus mages*, Zinken-Sammer, ovipositing on the underside of the leaves of a creeper with compound leaves, each leaf consisting of three leaflets, the *Illigera burmannica* of King, Natural Order *Combretaceæ*. The egg is spherical, smooth, pale green, almost transparent, and of the usual papilionid form. Unfortunately I was not able to breed the larva.

Family HESPERIIDÆ.

110. TAGIADES ATTICUS, Fabricius.

Hesperia atticus, Fabricius, Ent. Syst., vol. iii, pt. 1, p. 339, n. 288 (1793); *Tagiades atticus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 119.

In Southern India the larva of this butterfly feeds on *Dioscorea*, Natural Order *Dioscoreaceæ*, and *Smilax*, Natural Order *Liliaceæ*.

111. ODONTOPTILUM ANGULATA, Felder.

Pherygospidea angulata, Felder, Verh. zool.-bot. Gesellsch. Wien, vol. xii, p. 488, n. 149 (1862); *Achlyodes Sura*, Moore, Proc. Zool. Soc. Lond., 1865, p. 786; *Antigonus sura*, Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 120.

The larva in South India feeds on *Allophylus Cobbe*, Blunæ, Natural Order *Sapindaceæ*.

112. CAPRONA ALIDA, de Nicéville.

Caprona alida, de Nicéville, Journ. Bomb. Nat. Hist. Soc., vol. vi, p. 394, n. 37, pl. G, fig. 40, *male* (1891).

The transformations of this butterfly are unknown.

113. CAPRONA ELWESII, Watson.

Caprona elwesii, Watson, Journ. Bomb. Nat. Hist. Soc., vol. x, p. 674 (1897); *Caprona syrichthus*, var., Elwes, Proc. Zool. Soc. Lond., 1892, p. 656, pl. xliii, fig. 2.

The transformations of this butterfly are unknown.

114. ASTICTOPTERUS OLIVASCENS, Moore.

Astictopterus olivascens, Moore, Proc. Zool. Soc. Lond., 1878, p. 692; *Asticopterus* [*sic!*] *olivascens*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 124; *Cyclopides chinensis*, Leech, The Entomologist, vol. xxiii, p. 48 (1890); *Steropes nubilus*, Mabille, Bull. Soc. Ent. Belg., vol. xxxv, p. lxiv (1891); Leech, Butt. from China Japan and Corea, p. 630 (1893).

This obscure skipper has never been bred.

115. SUASTUS GREMIUS, Fabricius.

Hesperia gremius, Fabricius, Ent. Syst., a Suppl., vol. v, p. 433, n. 282-283 (1798); *Suastus gremius*, Walker, Trans. Ent. Soc. Lond., 1895, p. 474, n. 115.

The larva in India feeds on the leaves of palms, *Areca*, *Caryota*, *Phœnix*, *Calamus*, and *Cocos*, Natural Order *Palmeæ*.

116. IAMBRIX STELLIFER, Butler.

Astictopterus stellifer, Butler, Trans. Linn. Soc. Lond., Zoology, second series, vol. i, p. 555, n. 7 (1877); *Asticopterus* [*sic !*] (*Iambryx sic !*) *salsala*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 125.

This butterfly has never been bred, but the closely-allied *I. salsala*, Moore, in India feeds on bamboos and grasses, Natural Order *Gramineæ.*

117. TARACTROCERA ATROPUNCTATA, Watson.

Taractrocera atropunctata, Watson, Journ. Bomb. Nat. Hist. Soc., vol. x, p. 676, n. 275, pl. A, fig. 9, *male* (1897).

Transformations unknown.

118. HYAROTIS ADRASTUS, Cramer.

Papilio adrastus, Cramer, Pap. Ex., vol. iv, p. 62, pl. cccxix, figs. F, G, *male* (1780); *Hyatotis adrastus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 122.

The larva in Sumatra feeds on *Calamus*, and in India on *Phœnix* and *Calamus*, Natural Order *Palmeæ*, and doubtless on other palms.

119. MATAPA ARIA, Moore.

Hesperia aria, Moore, Horsfield and Moore, Cat. Lep. Mus. E. I. C., vol. i, p. 254, n. 587 (1857); *Matapa aria*, Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 108.

The larva in India feeds on the leaves of bamboos, *Bambusa*, *Dendrocalamus* and *Ochlandra*, Natural Order *Gramineæ.*

120*. ERIONOTA THRAX, Linnæus.

Papilio thrax, Linnæus, Syst. Nat. Ins., ed. xii, vol. *i*, pt. 2, p. 794, n. 264, (1767); *Erionota thrax*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 121.

Mr. James J. Walker records the breeding of this large skipper at Hongkong on banana leaves. In India also the larva feeds on species of *Musa*, Natural Order *Scitamineæ.*

121. NOTOCRYPTA FEISTHAMELLII, Boisduval.

Thymele feisthamelii, Boisduval, Voy l'astrolabe, Lep., p. 159, pl. iii, fig. 6 (1832); *Plesioneura alysos*, Moore, Proc. Zool. Soc. Lond., 1865, p. 789; *Notocrypta. alysos*, Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 109.

In the Western Himalayas the larva of this butterfly feeds on *Hedychium*, Natural Order *Scitamineæ ;* in South India it feeds on *Curcuma*, *Hedychium*, and *Amomum*, all Natural Order *Scitamineæ.*

122. UDASPES FOLUS, Cramer.

Papilio folus, Cramer, Pap. Ex., vol. i, p. 118, pl. lxxiv, fig. F, *female* (1775); *Udaspes folus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 476, n. 123.

The larva of this species in India feeds on *Curcuma*, *Kæmpferia*, *Hedychium*, and *Amomum*—all Natural Order *Scitamineæ*.

123. TELICOTA BAMBUSÆ, Moore.

Pamphila bambusæ, Moore, Proc. Zool. Soc. Lond., 1878, p. 691, pl. xlv, fig. 11, *male*; 12, *female*; *Telicota bambusæ*, Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 116.

The larva in India feeds on the leaves of bamboos, *Bambusa* and *Oxytenanthera*, Natural Order *Gramineæ*.

124. TELICOTA AUGIAS, Linnæus.

Papilio augias, Linnæus, Syst. Nat. Ins., ed. xii, vol. i, pt. 2, p. 794, n. 257 (1767); *Telicota augias*, Elwes and Edwards, Trans. Zool. Soc. Lond., vol. xiv, p. 251 (1897).

This species does not appear to have been bred. Messrs Elwes and Edwards record it from Hongkong, but it is very difficult to say from examining the markings only whether any particular specimen of this group of the genus from Hongkong is *T. bambusæ* or *T. augias*; in markings the specimens seem to be intermediate. Those gentlemen apparently make out differences between the two species in the form of the clasp in the males, which from the figures given by them (l. c., pl. xxv, figs. 62, 62*a*, *augias*, and 63, *bambusæ*) seem to be sufficient to distinguish the males.

125. PADRAONA DARA, Kollar.

Hesperia dara, Kollar, Hugel's Kaschmir, vol. iv, pt. 2, p. 455, n. 4 (1844); *Telicota dara*, Elwes and Edwards, Trans. Zool. Soc. Lond., vol. xiv, p. 255 (1897); *Telicota mæsoides*, Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 117.

The larva in South India feeds on *Bambusa*, *Oxytenanthera*, and *Ochlandra*, Natural Order *Gramineæ*.

126. HALPE CEYLONICA, Moore.

Halpe ceylonica, Moore, Proc. Zool. Soc. Lond., 1878, p. 690, pl. xlv, fig. 9, *male*; *Halpe moorei*, Watson, Proc. Zool. Soc. Lond., 1893, p. 109; Walker, Trans. Ent. Soc. Lond., 1895, p. 475, n. 118.

In South India the larva feeds on *Bambusa* and *Oxytenanthera*, Natural Order *Gramineæ*.

127. BAORIS OCEIA, Hewitson.

Hesperia oceia, Hewitson, Desc. Hesperidæ, p. 31, n. 22 (1868); *Baoris oceia*, Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 110.

The larva in South India feeds on *Bambusa*, *Dendrocalamus*, and *Ochlandra*, Natural Order *Gramineæ*.

128. CHAPRA MATHIAS, Fabricius.

Hesperia mathias, Fabricius, Ent. Syst., Suppl., p. 433, n. 289-290 (1798); *Chapra mathias*, Walker, Trans. Ent. Soc. Lond., 1895, p. 474, n. 113.

The larva in India feeds on rice *Oryza sativa*, Linn., and on grasses, Natural Order *Gramineæ*.

129. PARNARA CONJUNCTA, Herrich-Schäffer.

Goniloba conjuncta, Herrich-Schaffer, Prodr. Syst. Lep., vol. iii, p. 75, n. 44 (1869); *Hesperia narosa*, Moore, Proc. Zool. Soc. Lond., 1878, p. 687, pl. xlv, fig. 4, *male*; *Baoris narosa*, Walker, Trans. Ent. Soc. Lond., 1895, p. 474, n. 111.

The larva in South India has been bred on Indian Corn or Maize, *Zea Mays*, Linn., and on coarse broad-leaved grasses, Natural Order *Gramineæ*.

130. PARNARA ASSAMENSIS, de Nicéville.

Parnara assamensis, de Nicéville, Journ. A. S. B., vol. li, pt. 2, p. 65, n. 202 (1882); Wood-Mason and de Nicéville, Journ A. S. B., vol. lv, pt. 2, p. 382, n. 215, pl. xviii, figs. 5, 5*a*, *male*; pl. xvii, figs. 7, 7*a*, *female* (1886); *Baoris assamensis*, Walker, Trans. Ent. Soc. Lond., 1895, p. 474, n. 112.

This species has never been bred.

131. PARNARA GUTTATUS, Bremer and Grey.

Endamus guttatus, Bremer and Grey, Schmett. N. China's, p. 10, n. 43 (1853); *Parnara guttatus*, Walker, Trans. Ent. Soc. Lond., 1895, p. 474, n. 114.

The larva in India feeds on grasses and rice, *Oryza*, Natural Order *Gramineæ*.

132. PARNARA CONTIGUA, Mabille.

Pamphila contigua, Mabille, Bull. Soc. Zool., France, vol. ii, p. 232, *male* (1877); Elwes and Edwards, Trans. Zool. Soc. Lond., vol. xiv, p. 282 (1897).

This butterfly has never been bred.

133. PARNARA PELLUCIDA, Murray.

Pamphila pellucida, Murray, Ent. Month. Mag., vol. xi, p. 172 (1875).

Has never been bred to my knowledge.

134. PARNARA COLACA, Moore.

Hesperia colaca, Moore, Proc. Zool. Soc. Lond., 1877, p. 594, pl. lvii, fig. 7, *male*.

In South India the larva of this butterfly feeds on soft, small grasses, Natural Order *Gramineæ*.

135. PARNARA BEVANI, Moore.

Hesperia bevani, Moore, Proc. Zool. Soc. Lond., 1878, p. 688.

The larva in South India feeds on rice, *Oryza*, Natural Order *Gramineæ*.

136*. ISMENE ATAPHUS, Watson.

Ismene ataphus, Watson, Proc. Zool. Soc. Lond., 1893, p. 126; Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 106.

The larva in Ceylon and the Western Himálayas feeds on *Hiptage*, Natural Order *Malpighiaceæ*.

137*. HASORA VITTA, Butler.

Hesperia vitta, Butler, Trans. Ent. Soc. Lond., 1870, p. 498, Lep. Ex., p. 167, n. 3, pl. lix, fig. 9 (1874); *Hasara vitta*, Walker, Trans. Ent. Soc. Lond., 1895, p. 473, n. 107.

Originally described from Sarawak in Borneo. The sex of the type specimen is not stated by the describer. It has never been bred.

138. PARATA ALEXIS, Fabricius.

Papilio alexis, Fabricius, Syst. Ent., p. 533, n. 387 (1775); *Papilio cramus*, Cramer, Pap. Ex., vol. iii, p. 163, pl. cclxxxiv, fig. E, *male* (1780).

This is probably the species Mr. J. J. Walker records from Hongkong as *Hasora vitta*, Butler. The larva in Calcutta feeds on *Pangamia*, Natural Order *Leguminosæ*, and on *Heynea*, Natural Order *Meliaceæ*; in South India it feeds on the first-named plant.

139. RHOPALOCAMPTA BENJAMINII, Guérin.

Thymele benjaminii, Guérin, Delessert's Souv. voy. dans l'Inde, vol. ii, p. 79, pl. xxii, fig. 2.

The larva in Sikhim in the Eastern Himálayas feeds on *Sabia* Natural Order *Sabiaceæ*; and in the Western Himálayas on the same plant.

140*. CYCLOPIDES ETURA, Mabille.

Cyclopides etura, Mabille, Soc. Ent. Belg., vol. xxxv, p. lxxv (1891).

Described from a female from Hongkong. I have not been able to identify it, and Messrs. Elwes and Edwards omit it from their Revision of the Oriental *Hesperiidæ* in Trans. Zool. Soc. Lond., vol. xiv, pp. 101-324 (1897). Its food-plant is unknown.

II.—*Descriptions of some new species of* Orchideæ *from North-West and Central India.*—*By* J. F. DUTHIE, B.A., F.L.S., *Director, Botanical Department, North India.*

[Received 25th November, 1901. Read 4th December, 1901.]

Since the publication in 1898 of the four volumes on the Sikkim orchids by Sir George King and Mr. R. Pantling, I have been engaged during my spare time in the preparation of a similar work on the orchids of North-West and Central India. As, owing to more pressing work, there may be some delay in its completion, I have decided to publish at once the descriptions of some new species, which have been discovered within the period during which I have been able to make a special study of the subject.

For the greater portion of the material, on which the following descriptions are based I am indebted to my friend, Mr. P. W. Mackinnon, who for many years has taken a keen interest in the botany, and especially the orchids, of the Mussoorie district. Also, by his having carefully trained some intelligent hillmen in his service to work as collectors, some very interesting results have been obtained. I wish to express also my appreciation of Sir William Thiselton-Dyer's kindness in allowing me to consult Mr. R. A. Rolfe, the eminent orchidologist at the Royal Herbarium at Kew, from whom I have received great assistance.

1. MICROSTYLIS MACKINNONI Duthie, n. sp.

Whole plant 1-1·7 dm. high. Stem 3-4 cm., swollen below and rising from the base of the previous year's pseudo-bulb; lower portion enclosed within the leaf-sheaths. *Leaves* 2 or 3, horizontal, unequal in size, the larger one about 6 cm. long and 4 cm. broad, ovate, obtuse, 3-7-nerved, cordate and amplexicaul at the base, fleshy; upper surface dark brownish-green; main nerves 3-7, prominent beneath and purple-coloured, the interspaces raised above, and giving the whole leaf a bullate appearance. *Scape* reddish-purple, sharply 4-angular. *Raceme* shorter than the scape; *bracts* subulate, persistent, reflexed, longer than the ovary. *Flowers* sessile, very small, reddish-purple, resupinate. *Dorsal sepal* ovate-lanceolate, subacute; *lateral* shorter, subfalcate, edges of all reflexed. *Petals* linear, shorter than the sepals, much reflexed. Basal and apical portions of *lip* divided by a raised rim, basal lobes falcately ovate-lanceolate, contiguous, or overlapping at the tips; apical portion of lip deeply bifid and protruded, deep crimson-purple. *Column* with fleshy rounded arms. *Anther* with a truncate or emarginate lip. *Ovary* clavate, curved, not twisted.

Western Himālaya, near Mussoorie on the southern face of the Park Hill, up to 6,000 feet, *P. W. Mackinnon*; also on the Kalanga Hill in Dehra Dun, 2-3,000 feet, *Mackinnon's collector*.

Although most nearly related to *M. Wallichii*, the very different leaves at once distinguish this plant from any of the many forms of that species. It has also much smaller flowers and a very differently shaped lip.

2. OREORCHIS ROLFEI Duthie, n. sp.

Pseudo-bulb globose. *Leaves* two or three, about 2 dm. long by 1 to 1·5 cm. broad, deflexed at the tips. 3-5-nerved, plicate. *Scape* about as long as the leaves, rising from near the top of the pseudo-bulb. *Peduncle* firm, with 3 or 4 close-fitting tubular sheaths. *Raceme* many-flowered, about 6·7 cm. long. *Flowers* sessile, rather crowded, about 1·4cm. across. *Floral bract* minute, less than half the length of the ovary. *Sepals* about equal, 1·4 cm. long, lanceolate, subacute, pale yellowish-green, slightly spreading. *Petals* as long as the sepals, but narrower, oblanceolate, subacute, pure white with a few purple blotches. *Lip* obovate-oblong (when spread out), narrowed at the base into a short sac-like claw, side-lobes linear, fleshy, white, half the length of the mid-lobe; mid-lobe deflexed, white, and like the petals blotched with purple, apex with a shallow sinus, base of disc with a prominent fleshy oval channelled callus. Column curved, dilated at the base, concave in front. *Pollinia* globular, united to a short thick conical caudicle.

Western Himālaya, on Nág Tiba in Tehri-Garhwal, at an elevation of about 8,000 feet. *Mackinnon's collector*. Flowers in June.

This species is most nearly allied to *O. micrantha*, but the spike is shorter and the flowers are more crowded; it differs also by having a saccate base to the lip, and both the lip and petals are pure white spotted with purple. The callus at the base of the lip is oval and not linear. I have much pleasure in naming this orchid after Mr. R. A. Rolfe, of the Royal Herbarium at Kew.

3. CIRRHOPETALUM HOOKERI Duthie, n. sp.

Cæspitose. *Pseudo-bulbs* crowded, ovoid or nearly round, 1·5-1·7 cm. long. *Leaves* solitary on each pseudo-bulb, 3-4 cm. long and 1-1·2 cm. broad, linear-lanceolate or falcately so, tapering to the base, hardly petioled, notched at the obliquely obtuse or acute apex, coriaceous, dark green above, paler beneath, margin narrowly hyaline. *Scape* equalling or exceeding the leaves, issuing from near the base of the pseudo-bulb, lower portion enclosed within sheaths. *Flowers* 3-4, umbellate. *Floral bracts* 5 m. long, lanceolate, acuminate, membranous, shorter than the long-stalked ovary, margins incurved. *Dorsal sepal* 5 m. long, quite free at its base from the lateral pair, ovate, emarginate, concave and embracing the column, pale yellow with three broad reddish-purple veins; *lateral sepals* 2·1 m., cohering at their base and adnate to the foot of the column, twisted and constricted above their auricled base, linear-lanceolate and with acuminate cucullate tips, yellow with three to four bright red veins, which become indistinct upwards. *Petals* a little shorter than the dorsal sepal, broadly and obliquely ovate, rounded at the apex, yellow tinged with reddish-purple at the base. *Lip* deflexed from about the middle, oblong, with the margins incurved and forming a deep furrow on the upper surface, very thick and fleshy, yellow with reddish-purple blotches on the basal portion of the raised margins. *Column* thick, with a long incurved foot; apical processes 2, triangular, setaceous.

Western Himālaya: in Tehri-Garhwal, east of Tehri, epiphytic on *Rhododendron arboreum*, at elevations between 5 and 6,000 feet, *Mackinnon's collector.*

This species is most nearly related to *C. cæspitosum* of Wallich. It differs by having almost globular pseudo-bulbs and much longer scapes, the lateral sepals cohere at the base only; the petals are obtuse and quite entire; the shape of the lip is different, as is also the colouring of the flower. I have dedicated the species to my friend and benefactor, Sir Joseph D. Hooker, G.C.S.I., F.R.S.

4. EULOPHIA CAMPANULATA Duthie, n. sp.

Height of plant 9-15 dm., the leaves and scape rising from a horizontal, oblong tuber. *Pseudo-stem* formed by the sheaths enclosing the bases of the leaves and scape. *Leaves* few, linear, acuminate, 3-4·5 dm. long, and about 3 cm. broad; veins sharply prominent. *Scape* exceeding the leaves, with a few long tight-fitting acuminate sheaths towards the base. *Flowers* 6-10, in a lax raceme, appearing with the leaves, about 2·5 cm. in diam., erect in bud, drooping and campanulate when open. *Floral bracts* lanceolate, acuminate, less than half the length of the ovary. *Sepals and petals* prominently veined on the back, bright yellow outside and pale lemon-coloured within. *Dorsal sepal* obovate, cuspidate, 2 cm. long; *lateral*, rather shorter, falcately oblong, obtuse, or mucronate, adnate to the base of the column. *Petals* obovate, obtuse, about as long as the lateral sepals. *Lip* 3-lobed, longer than the sepals, with a short subacute conical sac at the base; side-lobes erect, large, rounded, pale yellow tinged with purple; mid-lobe bent upwards, and with reflexed undulate margin, suborbicular when flattened out; the disc with 5-8 prominent ridges terminating within the apex of the apical lobe in an oblong grooved callus, and prolonged at the base into two sets of fingerlike projections. *Column* about 1 cm. long, oblong, narrowly winged, curving into a short foot at the base. *Pollinia* 2, globose, attached by a cylindric caudicle to a triangular gland.

NORTH-WEST INDIA: Dehra Dun, at Karwapáni, *W. Bell*, and *P. W. Mackinnon's collector;* N. Oudh, at Chandanpur in the Gonda district. *Duthie's collector.*

Amongst the Indian species this very handsome orchid appears to be most nearly related to *E. Mannii*, Hk. f., which is found in Sikkim and in Upper Assam. It was originally discovered in Dehra Dun in 1879 by Mr. W. Bell, formerly Head Gardener at the Saharanpur Botanical Garden, after whom I have named it.

5. EULOPHIA MACKINNONI Duthie, n. sp.

Rhizome composed of a series of triangular flattened tubers. *Leaves* few, plicate, 5 to 6·5 dm. long and 5 to 8 cm. broad, appearing with the flowers, broadly lanceolate, acuminate, tapering into long sheaths, and with a few leafless sheaths below; nerves prominent. *Scape* 6-4 dm., arising from the swollen base of the pseudo-stem. *Flowers*, rather large, arranged in a lax raceme, spreading and afterwards deflexed. *Bracts* as long as, or shorter than, the ovary, linear, acuminate, persistent. *Sepals* and *petals* fleshy, yellow, tinged with reddish-brown, veins prominent outside. *Dorsal sepal* 1·7 cm. long, ovate, obtuse, subcordate at the base, 9-veined, margin inflexed at the apex; *lateral*, a little longer than the dorsal, unequal at the base. *Petals* shorter than the sepals, oblong-obovate, obtuse, overlapping and with their margins reflexed at the apex. *Lip* 3-lobed, with long erect rather shallow side-lobes, its body with 5-7 parallel purple-coloured ridges which extend into a carunculate area within the apical lobe; apical lobe rounded, its margin undulate. *Spur* short, geniculate. *Column* rather broad, winged, with no foot. *Anther* bicornute at the apex, its lip 2-toothed. *Stigma* transverse, placed immediately under the anther. *Pollinia*, tranversely oval, attached by a broad caudicle to a shallow crescent-shaped gland.

NORTH-WEST INDIA: Dehra Dun, *Mackinnon*; Siwalik range, *Vicary* (in Herb. Calc.); Bahraich district in N. Oudh, *Duthie's collector;* Raipur district in Cent. Provinces, *J. Marten.* In the Saharanpur herbarium there is an old specimen named "*E. bicolor*" which is said to have been collected near Mussoorie in October 1842.

This species is evidently allied to *E. geniculata*, King and Pantling, an extremely rare Sikkim orchid. It differs chiefly in the shape of the rhizome, the very much broader leaves, the colour of the flowers, and in the shape of the lip.

6. CYMBIDIUM MACKINNONI Duthie, n. sp.

Terrestrial, cæspitose. *Pseudo-stem* short, emitting many thick spongy roots. *Leaves* linear, acuminate, 3-4 dm. long and about 1·3 cm. broad; margins not serrulate, the lowest ones sheath-like and membranous. *Scape* 1-flowered, much shorter than the leaves, clothed to the base with loose lanceolate acuminate cymbiform hyaline sheaths. *Floral bract* longer than the much curved ovary, pale yellow with purple veins. *Flowers* about 5 cm. across, nodding. *Sepals and petals* spreading, green. *Sepals* lanceolate, obtuse, a little longer than the petals. *Petals* elliptic-lanceolate, obtuse, 5-nerved. *Lip* about as long as the petals, obovate-oblong (when spread out), 3-lobed, saccate at the base, very pale yellow blotched with purple; lateral lobes narrow, erect; the terminal one abruptly deflexed, rounded at the apex and nearly entire; the disk with two raised smooth lamellæ extending from the base to a little beyond the side-lobes. *Column* short, stout, curved, concave in front, marked with purple blotches like the lip. *Pollinia* 4, obliquely obovoid, plano-convex, the segments of each pair unequal, attached to a hemispherical gland. *Ripe capsule* 1·5 dm. long (including the long pedicel), ellipsoid-clavate, prominently ribbed.

WESTERN HIMĀLAYA: near Mussoorie, at an elevation of about 5,500 feet, growing under trees; in flower during February, *P. W. Mackinnon.*

Mr. Rolfe informs me that its nearest ally is *C. virescens*, Lindl., a native of Japan. Of Indian species it most nearly resembles *C. cyperifolium* in habit. It is, however, a much smaller plant, the scape is always 1-flowered, and the colouring of the lip and the shape of the pollinia and gland are very different; also the margins of the leaves are entire and not serrulate as in *C. cyperifolium.* The latter is also found in similar localities near Mussoorie, but always at a slightly higher elevation, and it comes into flower several weeks later.

7. LISTERA INAYATI Duthie, n. sp.

Whole plant 1·5 to 2 dm. high. *Roots* fibrous. *Stem* stout, about as long as the raceme, and bearing 3-6 loosely-fitting, blunt sheaths, the two upper ones sometimes opposite and leaflike. *Flowers* in dense racemes, 4 m. long; rachis glandalar-pubescent. *Floral bract* ovate or lanceolate-acuminate, a little longer than the stalk of the ovary. *Sepals and petals* connivent; *dorsal sepal* oval, concave, about 2 m. long; *lateral sepals* a little longer than the dorsal, obliquely ovate, tapering to an obtuse apex. *Petals* about as long as the dorsal sepal, spathulate, subacute.

Lip twice as long as the lateral sepals, narrowly oblong, deeply cleft at the apex, with two slightly spreading obtuse lobes, midrib thickened. *Column* short, stout, dilated at the base and apex. *Anther* suborbicular, bifid at the apex. *Pollinia* narrowly obovoid. *Ovary* oval or subglobose, about as long as its stalk, glandular-pubescent.

WESTERN HIMĀLAYA; in the Kagán valley of the Hazāra district. Discovered in July 1897 by *Inayat Khán*, head plant-collector of the Botanical Department of N. India (No. 22,596).

A shorter and much stouter plant than *L. Lindleyana*, and with shorter and more densely-flowered racemes. The shape of the sepals, petals, anther and pollinia are altogether different.

8. LISTERA MICROGLOTTIS Duthie, n. sp.

A leafless parasite, 2-3·3 dm. in height. *Root-fibres* clylindrical, brittle, pale yellowish-brown. *Stem* about as long as the receme, nearly white, bearing 2-4 loose-fitting obtuse pale sheaths. Rachis of raceme, pedicels and bracts glandular-pubescent. *Flowers* crowded, about 7 m. in diameter, pale green; pedicel a little longer than the ovary; *floral bract* equalling or exceeding the pedicel, oblong, obtuse or subacute. *Sepals* ovate, subacute, about 4 m. long; the lateral ones somewhat oblique. *Petals* as long as the sepals, linear, margins reflexed. *Lip* linear-spathulate, equalling the petals in length, entire at the apex, margins reflexed. *Column* erect, a little shorter than the petals, dilated towards its base and apex. *Pollinia* 2, globose, without caudicles, extremely deliquescent. *Ovary* with pedicel 8 m. long. *Capsule* turgid, its ridges thick and often bearing short, broad-based, tooth-like projections.

WESTERN HIMLĀAYA: in Tehri-Garhwál, east of Tehri, growing under oaks and rhododendrons at elevations between 5,000 and 6,000 feet, *P. W. Mackinnon's collector;* also on the wooded hillsides below Mussoorie at similar elevations. Flowers during August and September. This plant, although resembling *L. Lindleyana* in general habit, differs from any known species of *Listera* (including *Neottia)* by its very remarkably restricted petal-like lip.

9. APHYLLORCHIS GOLLANI Duthie, n. sp.

A tall leafless terrestrial herb, from 4 to 5 dm. in height. *Rhizome.* with numerous far-extending fleshy roots, not scaly. *Stem* erect, stout, bearing several unequal tubular blunt sheaths. *Raceme* about 1 dm. long, *Flowers* several, 2 cm. long. *Floral bract* a little longer than the ovary, elliptic-lanceolate, acuminate, 5-7-nerved, at first deflexed, ultimately erect. *Sepals* 2 cm. long, erect, ovate-lanceolate, acuminate, with spreading tips; their nerves, as also the ridges of the clavate ovary, dark reddish-brown on a pale green ground. *Petals* shorter than the sepals, lanceolate, acuminate, pale green with purple veins, midrib thickened on the back. *Lip* shorter than the petals, somewhat deflexed from a concave winged claw attached to the base of the column; apical portion ovate-acuminate, its sides towards the base erect and with a reflexed erose margin, with no convexity near the apex. *Column* 1·2 cm. long, stout, curved, narrowed towards the base. *Anther* 2-celled, cells parallel. *Pollinia* ovate-oblong, mealy. *Ovary* (in flower) 1·7 cm. long, its apex with conspicuous grandular projections between the ribs; *stigma* with an overlapping irregularly lobulate border.

WETSERN HIMĀLAYA: Tehri-Garhwál, on Nág Tiba, at elevations between 8,000 and 10,000 feet, *Gollan* (No. 2,062) and *Mackinnon's collector* (No. 23,000). The original specimens, discovered in 1881 by Mr. W. Gollan, after whom I have named this plant, were in too young a condition even for determining the genus. Its nearest ally is *A. alpina*, King and Pantling, a high-elevation Sikkim species. From the above it differs chiefly in the rhizome not being scaly, the bracts become erect as the flowers open, it has much shorter racemes, the lip is attached to the base of the column and does not form a pouch, the epichyle has no concavity at its apex, the colouring of the flowers is also very different.

10. POGONIA MACKINNONI Duthie, n. sp.

Tuber globose, annular and warted, about 1·2 cm. in diameter. *Leaf* and *scape* frequently from the same tuber, but not contemporaneous. *Leaf* about 5 cm. long and broad, cordate at the base, 7-lobed, terninal lobe acute, the others rounded, principal veins terminating at the end of each lobe, with many less conspicuous intermediate ones: *petiole*, 2·5 cm. long. Leaves from the flowering tubers much smaller. *Scape* 1-flowered, about 10 cm. long when in flower, elongatng till fruiting, enclosed by two or three rather loose tubular sheaths. *Flower* shortly pedicelled, spreading; *bract* erect, shorter than the cylindrical truncate ovary. *Sepals* spreading, linear-lanceolate, acuminate, 1·6 to 1·7 cm. long, light green blotched with reddish-brown outside. *Petals* very similar to the sepals, but a little shorter and not so acute at the apex. *Lip* shorter than the petals, oblong when spread out, strongly 3-nerved, white tinged with green towards the base; side-lobes erect, acute; terminal-lobe blotched with purple. *Column* slender, 7·8 m. long. *Pollinia* 2, narrowly clavate, connate below and without a gland.

WESTERN HIMĀLAYA: near Mussoorie, at elevations between 4,500 and 6,000 feet, *P. W. Mackinnon*. Flowers during May and June.

Very similar in habit to *P. macroglossa*, King and Pantling, but the leaves are more distinctly lobed; the flowers are much smaller, and are spreading, not drooping. Leaves and fruiting scapes are sometimes found on the same tuber.

11. HERMINIUM MACKINNONI Duthie, n. sp.

Whole plant upwards of 2·2 dm. high. *Tubers* narrowly oblong. Lower portion of the stem clothed with a few close-fitting tubular subacute sheaths. *Leaves* two, 12-14 cm. long by 1-2 cm. broad, oblong or linear-lanceolate, acuminate, with loosely amplexicaul tubular bases, 3-5-veined. *Spike* cylindric, rather broad, about 11 cm. long, many-flowered. *Flowers*, spreading, crowded, about 10 m. across. *Floral bract*, 5 m. long, broadly lanceolate, acuminate, a little shorter than the ovary. *Sepals* 3-4 m., ovate-oblong, acute, subterete, green. *Petals* as long as the sepals, linear-lanceolate, divergent, white. *Lip* trifid, a little longer than the petals, deflexed from near its base, white with a slight tinge of green, margins inflexed, lower portion very thick and with a small concavity at the base; side-lobes filiform, curved inwards; midlobe about half as long as the side-lobes, lanceolate, obtuse. *Anther-cells*, diverging below; *pollinia* obovate; *caudicles*, very short, the *glands* discoid, naked; *staminodes* large, spreading. *Stigmas* 2, transversely oblong and lying between the pollinia-glands and the concavity of the lip. *Ovary* about 6 m. long, ovate-oblong, beaked.

WESTERN HIMĀLAYA: near Mussoorie, at about 6,500 feet, on oak trees, *P. W. Mackinnon.* Flowers in August.

A very distinct species, its nearest ally being *H. angustifolium.* It differs from the latter by its fewer much shorter and broader leaves, its shorter and broader flowering spike, white petals and lip, and with the mid-lobe of the latter much longer; the shape of the ovary is also very different.

12. HABENARIA ELISABETHÆ Duthie, n. sp.

Height of plant up to 4·5 dm. *Bulbs* ovoid. *Leaves* 2-3, approximate towards the base of the stem, with a few lanceolate finely acuminate sheaths above and a few loose ones below them, 6·12 cm. long and 1 to 2 cm. broad, lanceolate, the upper acuminate, the lowest one acute or obtuse, amplexicaul at the base, midrib prominent beneath. *Spike* long and slender, sometimes up to 2·5 dm. *Flowers* sessiles, small, green, rather crowded, horizontal or deflexed. *Bracts* lanceolate, acuminate, about half as long as the ovary. *Sepals* erect, the dorsal one ovate, concave, the lateral ones obliquely ovate. *Petals* a little longer than the sepals, obliquely ovate, obtuse. *Lip* 3-cleft, fleshy, longer than the sepals, with a long concave claw; lateral lobes linear, spreading, gibbous at their basal edges; midlobe oblong, obtuse, not exceeding the lateral ones. *Spur* a short obovate sac, ½ the length of the ovary. *Anther-cells* parallel. *Pollinia* obovate, curved, attached by a short caudicle to an oval gland. *Stigmatic processes* clavate. *Ovary* tapering upwards and curved.

WESTERN HIMĀLAYA: Song, at 8,000 ft. *Brandis*; near Simla, *Edgeworth, Lady E. Babington-Smith;* near Naini Tal, up to 8,000 feet, *Colonel Davidson;* Tehri-Garhwál, 7,000 to 10,000 feet., *Duthie* (524 and 22,990), *P. W. Mackinnon;* also at Mussoorie, between 6,000 and 7,000 feet, frequently as an epiphyte on oak trees.

Of the Himālayan species of *Habenaria* this plant appears to be most nearly related to *H. goodyeroides.* It differs principally in having much narrower and thinner leaves, and they are placed much lower down on the stem. The flowering spikes are longer and narrower; the flowers are much smaller and altogether green; the floral bracts are shorter, and the shape of the lip is very different. I have much pleasure in dedicating this species to Lady Elizabeth Babington-Smith, whose keen and practical interest in the botany of Simla during the Viceroyalty of her father, Lord Elgin, resulted in several interesting discoveries.

III.—*Materials for a Flora of the Malayan Peninsula.*—*By* Sir George King, K.C.I.E., M.B., LL.D., F.R.S., &c., *late Superintendent of the Royal Botanic Garden, Calcutta.*

No. 13.

The present contribution carries these *Materials* to the end of the *Calyciflorœ*. The orders included in it are *Datiscaceœ*, *Droseraceœ*, *Passifloraceœ*, *Begoniaceœ*, *Ficoideœ*, *Umbelliferœ*, and *Cornaceœ*. It has not been possible for me to prepare my account of the Calycifloral orders in the exact sequence followed in Hooker's Flora of British India; each order, however, bears the ordinal number given to it in that work. The species described in the present paper are 47 in number, and of these fourteen belonging to the genus *Begonia*, and two belonging to *Mastixia*, are new to science. I hope in future contributions to take up the orders belonging to the groups *Corolliflorœ* and *Incompletœ*.

Order LXVII. DATISCACEÆ.

Trees or herbs. *Leaves* petioled, simple or pinnate; stipules 0. *Flowers* small, diœcious in the Indian species, clustered, racemed or panicled. Male: calyx-tube short, teeth 3–9; petals 0; stamens 4–25. Female: calyx-tube adnate to the ovary, lobes 3–8 short; petals 0; ovary 1-celled, open or closed at the vertex; styles lateral, alternating with as many parietal placentæ, simple or 2-partite; ovules very many, ascending or horizontal. *Capsule* coriaceous or membranous, opening at the vertex between the styles. *Seeds* very many, small, albuminous; embryo straight, radicle next the hilum.—Distrib. Species 4; natives of the Mediterranean, Central Asia, Java, and North-West America.

Tetrameles, R. Br.

A large tree. *Leaves* petioled, ovate, pubescent beneath at least on the nerves. *Flowers* diœcious, appearing before the leaves; males panicled, females in elongate racemes, clustered near the ends of the branchlets. Male: calyx-lobes short; teeth 4, ovate, one or two smaller teeth sometimes added; petals 0; stamens 4, opposite the calyx-teeth, inserted round a depressed disc; rudiment of the ovary 0 or quadrangular. Female: calyx-tube ovoid; teeth 4 short; petals 0; styles 4, short, stigmas simple somewhat club-shaped. *Capsule* ovoid, with 4 lines or slight ridges, membranous, opening at the top between the styles. *Seeds* very many, minute, flattened, ellipsoid, testa very lax and extending much beyond the nucleus as a loose membrane.

1. T. NUDIFLORA, R. Br. in Benn. Pl. Jav. Rar. 79, t. 17; A.DC. Prodr. XV. pt I. 411; Bedd. Fl. Sylv. t. 212; Brand. For. Fl. 245: Kurz For. Fl. 535; Clarke in Hook. f., Flor. Brit. Ind. II, 657. *T. Grahamiana*, Wight Ic. t. 1956; A.DC. l. c. *T. rufinervis*, Miq. Fl. Ind. Bat. I. pt. I. 726; A.DC. l.c. *Anictoclea Graham-iana*, Nimmo in Grah. Cat. Bomb. Pl. 252.—*Indeterminata*, Wall. Cat. 9045.

Andaman Islands; *Kurz.*—DISTRIB. Eastern Himālaya, Burma and Java.

Order LIV. DROSERACEÆ.

Herbs with large glandular hairs, exuding a viscid fluid. *Flowers* hermaphrodite, regular. *Petals* 5 hypogynous, rarely perigynous, thin, nerved, imbricate, marcescent, free or slightly united. *Stamens* 4 to 20, hypogynous or slightly perigynous; filaments free or slightly monadelphous, subulate or filiform: anthers 2-celled; disc none. *Ovary* free or adherent by its base to the calyx, globose or ovoid, 1-celled; *styles* 5, sometimes 3, simple or bifid; *stigmas* capitate; placentas parietal, equal in number to the styles; *ovules* and *seeds* numerous. *Capsule* membranous, 1-to 5-celled. *Seeds* with fleshy albumen; *embryo* cylindric or minute.—DISTRIB. Species about 100; in temperate and tropical regions generally, but absent from the Pacific Islands.

DROSERA, Linn.

Small perennial herbs. *Leaves* radical and rosulate, or cauline and alternate, bearing many large glandular viscid hairs, usually circinate in vernation, with scarious stipules adnate to the petiole, or exstipulate. *Calyx* persistent, free from the ovary, 4-to 8-partite or sepals free. *Petals* 4 to 8, hypogynous or very slightly perigynous, marcescent. *Stamens* equal in number to the petals, hypogynous or slightly perigynous. *Ovary* 1-celled; *styles* 2 to 5; *ovules* parietal, numerous. *Capsule* loculicidally 2-to 5-valved. *Seeds* numerous, obovoid-ellipsoid (in the Indian species); testa black, smooth, reticulate.—DISTRIB. Species about 90, cosmopolitan, but absent in Polynesia; Australia.

Leaves cuneate-spathulate, all radical ... ... 1 *D. Burmanni.*
Leaves peltate-lunate with long narrow petioles, some radical the others cauline ... ... 2 *D. peltata.*
Leaves linear, all cauline ... ... 3 *D. indica.*

1. DROSERA BURMANNI, Vahl Symb. III, 50. *Leaves* all radical, rosulate, cuneate-spathulate, ·5 to 1·5 in. long, stipules half as long as the petiole. Peduncles erect, 3 to 8 inches high, naked, glabrous. *Flowers* racemose, their pedicels glabrous, erect in fruit; calyx minutely papillose: styles 5, simple. Don, Prod. Fl. Nep. 212; DC. Prod. I, 318; Roxb. Fl. Ind., II, 113; Wall. Cat. 1242; Wight, Ill. t. 20; Wight, Ic.

944; W. & A. Prod. Fl. Penins. Ind. 34; Planch. in Ann. Sc. Nat. Ser. III. Vol. IX, 190; Miq. Fl. Ind. Bat., Vol. 1, pt. II, 120; Suppl. 160; Hf. & Th. in Journ. Linn. Soc. II., 82; Dalz. & Gibs. Fl. Bomb., 12; Kurz in Journ., As. Soc., Beng., 1876, pt. II, 310; Clarke in Hook. fil. Fl. Br. Ind. II, 424; Trimen, Fl. Ceyl. pt. II, 145.

MALACCA: Province Wellesley, and probably in the other provinces.—DISTRIB. British India, Ceylon, the Malay Archipelago, China, Japan, Africa, Australia, up to elevations of 8,000 feet.

2. DROSERA PELTATA, Sm. ex Willd. Sp. Pl. I, 1546. *Stem* erect, leafy, 3 to 12 in. high, simple or branched near the apex. *Leaves* sub-rosulate, also scattered and alternate on the stem, peltate-lunate, with very long glandular hairs, ·2 to ·25 in. broad (including the radiating hairs); the petiole much longer than the laminæ, very slender. *Racemes* 1 to 3 in. long, terminal or sub-terminal; flower-pedicels ·35 to ·75 in. long, glabrous. *Sepals* ovate, glabrous, erose or fimbrirate. *Styles* 3, fimbriate. *Seeds* as in *D. indica*, III. DC. Prod. I, 319; Sm. Exot. Bot., I, 41; Don Prod. Fl. Nep., 212; Wight. t., 20; W. & A. Prod. Fl. Penins. Ind., I, 34; Planch. in Ann. Sc. Nat. Ser. III, Vol. IX, 296; Kurz in Journ. As. Soc. Beng., 1876, pt. 2, 310; Clarke in Hook. fil. Fl. Br. Ind., II, 424; Trimen, Fl. Ceyl. pt. II, 146. *D. lunata*, Ham.: DC. Prod. 1, 319; Wall. Cat., 1243; Hook. Ic. Pl. 54; Planchon l.c., 296; Miq. Fl. Ind. Bat., II, Pt. 2, 120. *D. lunata*, *gracilis* et *D. foliosa*, Hook. fil. Journ. Linn. Soc., II, 82; 297, 298. *D. Lobbiana* Turcz. (fide Kurz).

MALACCA, SINGAPORE, and probably in some of the other provinces.—DISTRIB. Malay Archipelago, British India, and Australia.

3. DROSERA INDICA, Linn. Sp. Pl. 282. *Stem* 2 to 12 in. long, decumbent, usually simple. *Leaves* alternate, scattered, 1 to 3 in. long, linear, not much broader than the glabrous petiole, very glandular-pubescent. *Racemes* 2 to 6 in. long, leaf-opposed; flower-pedicels ·35 to ·75 in. long, rusty-pubescent. *Sepals* lanceolate, minutely glandulose or sub-glabrous. *Styles* 3, bifid to the base. *Seeds* obovoid, much reticulate not scrobiculate. DC. Prod., I, 319; Roxb. Fl. Ind., II, 113; Wall. Cat., 1244; Wight Ill. t., 20; W. & A. Prod. Fl. Penins. Ind., 34: Planch. in Ann. Sc. Nat. Ser., III, Vol. IX, 209; Miq. Fl. Ind. Bat., Vol. I, Pt. 2, 120; Hf. & Th. in Journ. Linn. Soc. II, 82; Dalz. & Gibs. Fl. Bomb., 12; Kurz in Journ. As. Soc Beng., 1876, Pt. II, 310; Trimen Fl. Ceyl., Pt. II, 146; Clarke in Hook. fil. Fl. Br. Ind., II, 424. *D. Finlaysoniana*, Wall. Cat., 3752. *D. serpens*, Planch. l.c., 204.—Rheede, Hort. Malab., X, t. 20.

MALACCA: Province Wellesley, and probably in the other provinces.—DISTRIB. British India, Ceylon, Malayan Archipelago, tropical Australia, and Africa.

Order LI. PASSIFLOREÆ.

Twining herbs or shrubs, rarely erect. *Leaves* alternate, stipulate, entire or lobed, penni- or palmi-nerved, frequently glandular beneath. *Petiole* usually bearing glands. *Stipules* foliaceous or minute. *Tendrils* axillary or 0. *Inflorescence* axillary, cymose, sometimes with one or more branches cirrhose, rarely flowers solitary. *Bracteoles* 3, minute and scattered, or foliaceous and forming an epicalyx, rarely 0. *Flowers* regular, unisexual, or bisexual. *Calyx* tubular at the base, fleshy, subcoriaceous or membranous; segments imbricate, 5. *Petals* 0 or as many as the calyx-lobes, springing from the tube of the calyx, membranous or fleshy, imbricate, marcescent. *Corona* of one or more rows, filamentous or membranous or both, arising from various portions of the calyx-tube, rarely 0; basilar corona urceolate or cup-shaped, surrounding the base of the andrœcium, sometimes represented by five separate glands of the disc; rarely 0. *Stamens* 5, in a tube or free to the base, perigynous; anthers oblong, 2-celled, basi- or dorsi-fixed, dehiscing laterally or introsely. *Ovary* superior, on a gynophore or subsessile, 1-celled with 3 parietal placentas, rudimentary or absent in the male flowers. *Styles* 1 or 3; stigmas reniform, capitate or flattened. *Ovules* numerous, pendulous, anatropus; funicle expanded into a cup-shaped arillus. *Fruit* baccate or capsular. *Seeds* numerous, ovoid or flattened, often pitted, covered with a fleshy arillus; albumen fleshy, rarely scanty; embryo straight, cotyledons flat leafy, radicle short terete.—DISTRIB.: Chiefly tropical; most numerous in South America. Genera about 18; species about 320.

Erect shrubs, without tendrils ... ... 1 PAROPSIA.
Scandent, with tendrils:—
  Fruit pulpy, indehiscent; flowers large ... ... 2 PASSIFLORA.
  Fruit dehiscent; flowers small ... ... 3 ADENIA.

1. PAROPSIA, Noronh.

Shrubs. *Leaves* simple. *Flowers* in dense axillary cymes. *Calyx-tube* short; limb 5-parted. *Petals* 5, springing from the base of the calyx-tube. *Corona* of fine threads springing from the tube of the calyx and more or less divided into five phalanges. *Gynophore* short; filaments flat; anthers oblong. *Ovary* subglobose. *Style* short, dividing into three branches; stigmas reniform-capitate. *Fruit* capsular.—DISTRIB. Species 4 or 5, natives of tropical Africa and Malaya.

P. VARECIFORMIS, Mast. in Trans. Linn. Soc., XXVII, 639. A shrub or small tree. *Leaves* subcoriaceous, oblong or oblong-lanceolate, acute or shortly acuminate, the base cuneate, the edges entire or (rarely) minutely serrate; both surfaces glabrous except the glandular puberulous midrib and nerves; the lower with numerous minute adpressed scales; main 6 or 7 pairs spreading, curved; length 2·5 to 5·25 in., breadth 1 to 1·75 in., petiole ·1 to ·2in. *Flowers* about ·5 in. in diam., on short, rusty-tomentose pedicels ·15 in. long. *Calyx* campanulate, leathery, adpressed-villose outside like the pedicels, the lobes much longer than the tube, unequal, oblong, subacute. *Petals* oblanceolate, smaller than the calyx-lobes. *Corona* single, very short, lanate, in 5 phalanges. *Stamens* 5. *Gynophore* shorter than the corona; ovary villose. *Fruit* ovoid or sub-globose, ·5 to ·7 in. across. Masters in Fl. Br. Ind., II, 600. *P. malayana*, Planch. ex Masters l.c. *Trichodia vareciformis*, Griff. Notul., IV, 571.

MALACCA: Griffith, Manigay, and others. PERAK: Scortechini, King's Collector; a common plant.

I can find no constant characters to separate the two species into which this plant has been divided in the Flora of British India and therefore unite them under the oldest specific name.

2. PASSIFLORA, Linn.

Twining shrubs. *Leaves* simple or palmilobed, usually with glands on the under surface and on the petiole; stipules thread-like or leafy. *Flowers* pedunculate; often involucrate; peduncles simple or cymose. *Bracteoles* 3, small, scattered. *Calyx-tube* fleshy, limb 5-lobed. *Petals* 5, springing from the throat of the calyx. *Corona* of one or more rows of fine threads springing from the throat of the calyx-tube and of one or more membranous folds arising lower down. *Gynophore* surrounded at the base by a shallow membranous cup or basilar corona; filaments 5, flat; anthers oblong, 2-celled, dorsifixed; pollen-grains reticulate on the surface. *Ovary* 1-celled; styles 3, stigmas reniform-capitate. *Fruit* baccate. *Seeds* arillate.—DISTRIB. A genus of about 250 species which are most numerous in tropical and sub-tropical America.

PASSIFLORA HORSFIELDI, Blume, Rumphia, I, 170, t. 52. A slender climber; young branches slightly quadrangular, slender, striate, almost glabrous. *Leaves* membranous, oval or oblong-ovate, subacute sometimes retuse, the base rounded and minutely emarginate; upper surface pale-brown when dry, shining, glabrous, minutely reticulate; lower surface when young sometimes with sparse deciduous hairs, but more usually glabrous from the first, always dull and whitish and with a few flat dark-coloured glands, the transverse veins and reticulations very distinct; main-nerves about 5 pairs, ascending, faint; length 4 to 6 in.; breadth 2·5 to 3·25 in.; petiole ·6 to ·9 in., with two oval flat glands near its middle. *Inflorescence* shorter than the leaves, axillary, about 5-flowered, the flowers 1·25 to 1·5 in. in diam., on slender long pedicels, white tinged with green; corona double, the outer with long erect filamentous segments; the inner about one-fourth as long, its segments few, lanceolate, incurved. *Stamens* 5; the filaments spreading, clavate; anthers dorsifixed, oblong. *Ovary* ovoid, hirsute, the gynophore nearly as long as the outer corona; styles long, recurved. *Fruit* subglobular, ·75 in. in diam. *Disemma Horsfieldii*, Miq., Fl. Ind. Bat., I, Pt. 1, 700.

PERAK; *Scortechini* 655, 2,192; *King's Collector* 3,078, 4,104, 5,936, DISTRIB.—Java and Madura.

This is apparently the only species really indigenous in the Malayan Peninsula. There are, however, four American species which have escaped from cultivation. These are:—

P. suberosa, L. A small species with diversely shaped leaves, flowers little more than half-an-inch in diameter and ovoid fruits about the same in length.

P. foetida, L. A species with variable leaves, emarginate at the base, often 3-lobed; recognisable at once by its foetid flowers and 3-leaved fimbriate involucre.

P. edulis, Sims. With deeply 3-lobed serrate leaves, flowers more than an inch across; and globular edible fruit. This is often cultivated under the name of *Granadilla*.

P. quadrangularis, L. A large species with boldly 4-angled stems; handsome fragrant, purple flowers banded with white, 3 to 5 in. across; broadly ovate leaves and large oblique ovate-oblong stipules.

P. laurifolia, L. A more slender species than the last and with smaller flowers of similar colour, with a large 3-leaved or 3-partite involucre of broad segments, and of long filiform stipules; the leaves broadly oblong, entire and shortly apiculate.

3. ADENIA, Försk.

Scandent. *Leaves* entire or palmilobed, usually with two or more flat circular glands on the under surface and with similar glands at the apex of the petiole. *Cymes* axillary, few or many-flowered, on long peduncles, one or more of which is sterile and tendril-like. MALE FLOWER: *Calyx* tubular or bell-shaped; limb 5-lobed, lobes leathery, imbricate. *Petals* 5, free, membranous, 1-nerved, springing from the calyx-tube. *Corona* a ring of threads arising from near the base of the calyx-tube, or wanting. *Glands of the disc* 5, opposite the sepals, strap-shaped or capitate. *Andrœcium* cup-shaped, membranous beneath; filaments 5, linear-subulate; anthers linear-oblong, 2-celled. *Ovary* rudimentary or 0. FEMALE FLOWER: *Calyx* and *corolla* as in the male. *Corona* a membranous fold, springing from near the base of the calyx-tube, or none. *Glands of the disc* 5, strap-shaped, capitate, opposite the sepals. *Staminodes* 5, forming a membranous cup surrounding the base of the ovary, above dividing into barren filaments. *Ovary* globose or elliptic, sessile or stalked; style cylindrical or none; stigmas 3, capitate or flat and dilated. *Fruit* capsular, 3-valved. *Seeds* numerous, attached by long funicles to parietal placentas.—DISTRIB. About 40 species, natives of the tropics of the Old World.

NOTE.—The name used for this genus in Hooker's Flora of British India is *Modecca*, Lamk. which dates from 1797. Following Engler, I have here used Förskal's name *Adenia*, which dates from 1775.

Leaves always deeply 3-lobed ... ... 1 *A. trilobata.*
Leaves entire :—
    Leaves minutely peltate at the base ; lobes of calyx long, narrow and reflexed ... ... 2 *A. nicobarica.*
    Leaves cordate at the base :—
        Base broadly and deeply cordate, main-nerves radiating from the base : flowering peduncles up to 6 in. long ... ... 3 *A. cardiophylla.*
        Base slightly cordate : main-nerves pinnate : flowering peduncles less than 2 in. long ... 4 *A. populifolia* var. *pentamera.*
    Leaves not cordate at the base or only occasionally very slightly so : main-nerves usually 2 sometimes 3 pairs :—
        Nerves and reticulations of leaves distinct ... 5 *A. acuminata.*
        Nerves and reticulations of leaves invisible, the lower surface of the leaves whitish ... ... 6 *A. singaporeana.*

1. ADENIA TRILOBATA, Engl. Jahrb., XIV, 375. Many feet in length, glabrous, the bark on the old shoots cinereous, on the young smooth green. *Leaves* remote, membranous, broadly cordate at the base, deeply 3-lobed ; the lobes lanceolate, the two outer often auriculate at the base, the sinuses wide, rounded, and each bearing a small gland ; main-nerves 5, palmate ; the lateral nerves and the reticulations few ; length 6 to 9 in. ; width 4·5 to 6·5 in. ; *petioles* from half as long to nearly as long as the leaf-blades, terete, smooth, not enlarged at the base, the apex with two conical recurved glands. *Peduncles* slender, smooth, terete, axillary, longer than the petioles, umbellulately cymose ; flowers few, ·3 to ·5 in. long, the females somewhat longer than the males. *Calyx* tubular, the lobes short, oblong, subacute. *Petals* narrowly oblong, inserted near the base of the calyx-tube. *Filaments* united into a tube springing from the fundus of the calyx ; *anthers* linear-oblong, abruptly acute, the connective produced into a minute point. *Glands* narrowly oblong, blunt, incurved. *Staminodes* in female flower united into a membranous cup. *Rudimentary* ovary in male flower trifid. *Fruit* oblong, scarlet, from 2 to 2·5 in. long when ripe, and 1·5 in. in diam. *Seeds* compressed, sub-obcordate or sub-rotund, scrobiculate, the arillus thin, clear. *Modecca trilobata*, Roxb. Hort. Beng., 49 ; Roxb. Corom. Plant. III, t. 297 ; Fl. Ind., III, 133 ; Wall. Cat., 1234 ; Kurz, in Journ. As. Soc., Beng., 1877, II, 95 ; Masters in Hook. fil. Fl. Br. Ind., II, 602.

ANDAMAN ISLANDS ; common.—DISTRIB. Northern parts of British India and Burma.

2. ADENIA NICOBARICA, King. Slender and slightly branched, glabrous *Stems* minutely sulcate, thin, wiry. *Leaves* membranous,

entire, narrowly elliptic-oblong or lanceolate; the base rounded and minutely bi-glandular, slightly peltate; the apex acuminate, rarely abruptly acute; both surfaces shining; main-nerves only about 4 pairs, interarching broadly and far from the edge; intermediate nerves horizontal; reticulations wide; length 2·5 to 4·5 in.; width ·6 to 1·8 in.; petiole ·4 to ·8 in., compressed, not enlarged at the base. *Peduncles* longer than the petioles but much shorter than the leaves, bearing a filiform tendril and only one or two flowers. *Flowers* rather less than ·5 in. long, green. FEMALE FLOWER unknown. MALE FLOWER ·4 to ·5 in. long *Calyx* campanulate, deeply divided into 5 linear-oblong, subacute, much reflexed lobes. *Petals* shorter than the calyx and inserted into it below the middle, membranous, reticulate, oblanceolate, their apices truncate and broad. *Glands* short, oblong, truncate. *Anthers* about equal to the petals, oblong, obtuse, cordate at the base; the filaments united into a wide tube. *Fruit* elliptic-oblong, tapered to each end, from 1·5 to 2·3 in. long, and ·75 in. in diam., reddish when dry, smooth. *Seeds* much compressed, sub-orbicular, with a few shallow pits in the centre, and a row of short depressed radiating grooves round the edge, the aril very thin. *Modecca nicobarica*, Kurz in Trimen's Journ. Bot. for 1875, p. 327; Mast. in Hook. fil. Fl. Br. Ind. II, 603.

ANDAMAN and NICOBAR ISLANDS; not uncommon. MALACCA; *Maingay* (Kew Distrib.) 670. PERAK; *Wray* 651, 2781; *King's Collector* 2439; *Scortechini* 633; *Ridley* 10280. PENANG; *Curtis* 1521.

A species distinguished by its entire oblong leaves minutely peltate at the base, by its long narrow reflexed calyx-lobes, and by its rotund seeds with *shallow* pits in the centre and radiating grooves at the edges.

3. ADENIA CARDIOPHYLLA, Engl. in Jahrb. XIV, 376. Rather stout, glabrous. *Stems* almost terete. *Leaves* membranous, remote, broadly ovate, rotund-ovate, sometimes almost sub-reniform, the base deeply cordate, the auricles rounded; the apex with a short triangular point; both surfaces smooth; the lower with numerous distinct reticulations; main-nerves about 9, radiating from the base; the secondary nerves sub-horizontal, numerous; length 5 to 9 in.; breadth 3·5 to 7·5 in.; petiole 2 to 4·5 in. long, not thickened at the base but with 2 sessile glands at the apex. *Peduncles* 4 to 6 in. long, longer than the petioles, with several widely-spreading cymose branches and usually one tendril. MALE FLOWER narrowly ovoid, ·2 in. long. *Calyx* leathery, spotted inside, the mouth with blunt short teeth. *Petals* thin, broadly oblong-lanceolate, sub-acute, spotted, their apices level with those of the teeth of the calyx, their bases inserted about the middle of the calyx-tube. *Glands* short, oblong-cuneiform. *Anthers* linear-ovate, acute, the filaments united into a tube inserted into the fundus of the calyx. FEMALE FLOWER twice as

long as the male, tubular. *Calyx* as in the male, the teeth recurved. *Petals* as in the male, their apices entire or minutely serrulate. *Ovary* ovoid, on a short gynophore, the stigma peltate 3-lobed. *Fruit* broadly fusiform, 2 to 2·5 in. long and 1 in. in diam. at the middle, dirty-yellowish when dry. *Seeds* compressed, sub-rotund, keeled, with prominent sharply edged deep pits in the centre and a row of elongate pits round the edges. *Modecca cardiophylla*, Mast. in Hook. fil. Fl. Br. Ind. II, 602. *Modecca cordifolia*, Kurz, (not of Blume) in Journ. As. Soc. Beng., 1876, II, 132: Masters in Hook. fil. Fl. Br. Ind. II, 602. *M. heterophylla*, Kurz, (not of Blume) Andam. Report Append. A., 39.

ANDAMAN ISLANDS; very common. NICOBAR and GREAT COCO ISLANDS; *Prain.*—DISTRIB. Cambodia, Khasia Hills and Eastern Bengal, tropical Eastern Himalaya.

A species well marked by its deeply cordate leaves much reticulate on the lower surface, widely-spreading cymes and sub-rotund cancellate pitted seeds. Some confusion in nomenclature has arisen from the fact that Kurz, without having seen authentic specimens of Blume's two species *Modecca cordifolia* and *M. heterophylla* referred this plant to both of them. Dr. Masters perpetuated part of Kurz's mistake by accepting his view as to the identity of this Andaman and Nicobar plant with *M. cordifolia*, Blume, whereas the whole of the Andaman material (greatly increased in bulk since he wrote) really belongs to his own species *M. cardiophylla*. This view was first expressed by Dr. D. Prain, Superintendent of the Calcutta Garden in a note on one of the specimens in the Herbarium there.

4. ADENIA POPULIFOLIA, Engl. in Jahrb. XIV, 376, var. PENTAMERA King. A slender and often very extensive climber (often 150 feet) *Stems* slender, smooth, terete. *Leaves* thinly coriaceous, oblong-ovate, gradually narrowed to the acute or sub-acute apex, the base slightly cordate; both surfaces smooth, the nerves and reticulations little prominent when dry: main-nerves 5 to 7 pairs, curved, spreading, rather faint; length 3 to 5 in.; breadth 1·75 to 2·5 in.; petiole ·75 to 1·25 in., its apex bearing 2 large cup-shaped glands conjoined by their backs. *Peduncles* shorter than the leaves with 2 slender spreading branches and a single rather stout tendril. *Flowers* not numerous, on slender unequal pedicels, some of them ·75 in. long. MALE FLOWER ·2 in. long, narrowly fusiform; the calyx with 5 short oblong blunt lobes. *Petals* springing from the calyx-tube just below its lobes, and like them but narrower. *Anthers* 5, broadly linear, the connective slightly produced beyond the apex, shortly sagittate at the base; filaments joined into a tube and inserted into the fundus of the calyx: rudimentay ovary linear. FEMALE FLOWER shorter than the male (only ·15 in. long) and not so slender but with similar calyx-lobes and petals. *Ovary* oblong, crowned by three erect oblong rather large stigmas. *Fruit* double fusiform, deep red when ripe, 2·5 to 3 in. long and from ·75 to 1 in. in

diam. *Seeds* broadly oblong, compressed, foveolate with a row of short radiating grooves round the edges. *Modecca populifolia*, Blume Rumphia, 168 t. 50. *M. populifolia*, Bl.: Masters in Hook. fil. Fl. Br. Ind. II, 603 (*amongst imperfectly known species*).

MALACCA; *Maingay* (K.D.) 668. PERAK; *Scortechini* 1609; *King's Collector*, many Nos.

Blume describes and figures his *Modecca populifolia* plant as tetramerous and as this exactly agrees both with his text and figure, except in being pentamerous, I regard it as a variety. There are in Herb. Calcutta specimens from Perak without flower or fruit, of what appears to be a 3-lobed form of this.

5. ADENIA ACUMINATA, King. *Stems* slender, striate. *Leaves* sub-coriaceous, ovate-oblong or rotund-ovate, the base usually narrowed but sometimes sub-cordate always bi-glandular; the apex shortly and abruptly acuminate; the secondary nerves and reticulations distinct on both surfaces when dry but especially on the lower; main-nerves 2 or sometimes 3 pairs, originating from the midrib near its base, all prominent: length 4 to 6 in.; breadth 2 to 4 in.; petiole ·75 to 1·35 in. long. *Peduncles* usually nearly as long as the leaves but sometimes much shorter, bearing a few short many-flowered spreading branches at the apex and often a short tendril. MALE FLOWER narrowly ovoid, ·25 to ·3 in. long. *Calyx* leathery with 5 short ovate-lanceolate lobes. *Petals* thick, oblong, acute, springing from the calyx-tube above the middle. *Glands* small, lanceolate. *Anthers* linear, sub-acute, erect, the filaments short. FEMALE FLOWER larger than the males (·4 in. long), tubular, swollen in the lower third. *Calyx-lobes* very short, broad, blunt, incurved. *Petals* narrowly oblong, sub-acute, incurved. *Ovary* fusiform. *Fruit* fusiform, dull, reddish when dry, about 2 in. long and ·75 in. in diam. at the middle. *Seeds* compressed, subrotund, boldly pitted in the centre and with a marginal row of radiating grooves on each side, slightly oblique and pointed at the base. *Modecca acuminata*, Blume Bijdr. 940; Miq. Fl. Ind. Bat. I, Pt. 1,702. *M. singaporeana*, Mast. in Hook. fil. Fl. Br. Ind. II, 601 (*in part*).

PERAK; *Scortechini* 254, 459, 629; *Wray* 498, 1745; *Ridley* 9462, 9632; *King's Collector*, many numbers. SELANGOR; *Ridley* 7288. MALACCA; *Goodrich* 1340.—DISTRIB.; Java, Sumatra, (*Beccari* P.S. 743).

6. ADENIA SINGAPOREANA, Engl. in Jahrb. XIV, 376. *Stems* slender, striate. *Leaves* subcoriaceous, oblong to ovate-oblong, cuneate and bi-glandular at the base, the apex sub-acute or shortly and bluntly acuminate; both surfaces smooth, opaque, the lower very pale, the secondary nerves and reticulations very indistinct on both; main-nerves 3 pairs, the lower two pairs bold and ascending, the upper pair less bold and spreading; length 3·5 to 4·5 in.; breadth 1·75 to 2·25 in.; petiole

·5 to 1·5 in. long. *Peduncles* about as long as the petiole, few-flowered. *Male flowers* (*fide* Masters) "·25 in. long, elongate, fusiform. *Calyx* leathery, shortly 5-lobed; lobes ovate, connivent (? always). *Petals* thick, leathery, oblong-acute, springing from the calyx-tube just beneath the throat. *Corona* none (?). *Glands* of the disc 5, small, oblong, at the base of the calyx-tube, opposite to its lobes. *Stamens* 5; anthers sub-sessile, erect, linear; connective long, thread-like. *Rudimentary ovary* fusiform. *Fruit* 2 in. long, glabrous, fusiform." *Seeds* compressed, sub-ovoid, obliquely contracted to a short podosperm, the centre boldly tubercled, the edges with a row of broad grooves the tubercles between which on the extreme margin are bold and some of them black. *Passiflora singaporeana*, Wall. Cat. 1232. *Modecca singaporeana*, Masters in Hook. fil. Fl. Br. Ind. II, 601.

SINGAPORE; *Wallich.* JOHORE; *King.* MALACCA; *Maingay* (K.D.) 667.—DISTRIB. Java.

A species badly represented in collections and misunderstood. It is based on the plant collected by Wallich at Singapore and issued by him under his Cat. No. 1232 and named *Passiflora singaporeana*. With this agree absolutely a plant collected by Mr. Hullett and myself at Jaffaria (in Johore) also some specimens collected by Mr. H. O. Forbes in the Preanger in Java (*Herb. Forbes* 565). Maingay collected at Malacca six specimens of a *Modecca* all of which in Herb. Kew. are named *M. singaporeana*. In my opinion five of these belong to *M. acuminata*, Bl. I have seen no flowers of *M. singaporeana* and the account of them given above is copied verbatim from Masters. The leaves are very opaque and of a dull pale colour beneath, and the nerves are very faint. The fruit is slightly shorter than that of *M. acuminata*, Bl. of which species this is I fear little more than a form.

Order LII. BEGONIACEIÆ.

Succulent herbs or undershrubs; stem often rhizomatous or tuberous. *Leaves* alternate (sometimes falsely whorled), more or less unequal-sided, entire, toothed or lobed; stipules 2, free, frequently deciduous. *Peduncles* axillary, dichotomously cymose, the branches and bracts at their divisions generally opposite. *Flowers* white rose or yellow, showy, sometimes small, monœcious. MALE: perianth (of the only Indian genus) of 2 outer valvate opposite sepaloid segments, and 2-0 inner smaller segments; stamens indefinite often very many, free or monadelphous, anthers narrowly obovoid. FEMALE: perianth (of the only Indian genus) of 5-2 segments. *Ovary* inferior (in *Hildebrandia* half-superior), 2-3-4-celled; placentas vertical, axile (at the time of æstivation), divided or simple; styles 2-4, free or combined at the base, stigmas branched or tortuous; ovules very many. *Fruit* capsular, more rarely succulent, often winged, variously dehiscing or irregularly breaking up. *Seeds* very many, minute, globose or narrow-cylindric, testa reticulated: albumen very scanty or 0.—Distrib. Species 400 (of which 398 belong to the genus *Begonia*), in all tropical moist countries; not yet met with in Australia.

1. Begonia, Linn.

Characters of the Order.

Group I. Capsule 3-celled, with 3 nearly equal narrow vertically oblong wings, dehiscing by 2 oblong valves on each face between the wings :—

Small acaulescent herbs, only a few inches in height: leaves rotund-ovate slightly oblique ... ... 1. *B. Forbesii.*

Herbs with stems 2 or 3 feet high; leaves obliquely ovate-oblong or ovate-lanceolate, the base cordate and very unequal-sided :—

Male flowers ·2 to ·3 in. across ... ... 2. *B. isoptera.*

Male flowers 1·5 in. across ... ... 3. *B. isopteroidea.*

Group II. Capsule 2-celled, triquetrous, with 3 short unequal wings, dehiscing irregularly by the breaking up of the fragile faces between the wings; anthers obovoid, often emarginate at the apex :—

Caulescent; rootstock tuberous :—

Upper surfaces of leaves with numerous adpressed white stellate hairs; bracts of inflorescence ·05 to ·1 in. long, densely adpressed-pubescent; male flowers ·2 to ·25 in. in diam.; capsules about 3 in. broad ... 4. *B. sinuata.*

Upper surfaces of leaves scantily adpressed hairy; bracts ·35 to ·5 in. long, glabrous; male flowers 5 in. and capsules ·6 in. across ... ... 5. *B. andamensis.*

Leaves glabrous ... ... 6. *B. debilis.*

Acaulescent; rhizome creeping :—

Leaves rather thick (when dry), rotund-reniform, deeply cordate the basal lobes overlapping, the nerves beneath and the petioles rusty-tomentose ... 7. *B. thaipingensis.*

Leaves very thin (when dry), obliquely ovate-reniform, quite glabrous except for a few sparse hairs on the under surface of the nerves; petioles glabrous ... 8. *B. guttata.*

Group III. Capsule 2-celled, triquetrous with 3 wings one of which is much elongated transversely so as greatly to exceed the other two, dehiscing by the rapture of the stout membranous faces between the wings :—

Anthers cuneiform-oblong; leaves peltate ... ... 9. *B. Hasskarlii.*

Anthers linear-oblong or linear; leaves not peltate :—

Leaves not at all or very little oblique even at the base, not cordate; petioles very long :—

Leaves with coarse hairs on both surfaces :—

Leaves narrowly lanceolate ... ... 10. *B. Scortechinii.*

Leaves ovate-lanceolate ... ... 11. *B. Kunstleriana.*

Leaves glabrous :—
Leaves broadly elliptic-ovate, equal-sided at the base 12. *B. Herveyana.*
Leaves ovate-lanceolate, unequal-sided especially at the base ... ... 13. *B. perakensis.*
Leaves very oblique, ovate to reniform, obliquely cordate at the base :—
Leaves glabrous even on the nerves :—
Male flowers less than 1 in. across ... . 14. *B. paupercula.*
Male flowers about 1·5 in. across ... ... 15. *B. venusta.*
Leaves glabrous, but the nerves hairy ; male flower 2 in. across ... ... 16. *B. megapteroidea.*
Leaves with a few coarse compressed rusty-pubescent hairs on both surfaces ; nerves beneath, petioles and also peduncles rusty-pubescent ; male flowers ·8 in. across ... ... 17. *B. Maxwelliana.*
Upper surfaces of leaves papillose and bearing coarse hairs :—
Acaulescent ; petiole much longer than the lamina 18. *B. praeclara.*
Stems 3 feet high ; petiole shorter than the blade 19. *B. Lowiana.*

1. BEGONIA FORBESII, King n. sp. A small plant a few inches high with densely rusty-villose rhizome. *Leaves* rotund-ovate shortly apiculate, sometimes blunt, the base slightly cordate, the edges subentire or remotely denticulate ; upper surface glabrous : the lower with numerous white scales and a few coarse hairs on the nerves near their bases : main-nerves 9, radiating from the base, inconspicuous ; length 1·25 to 2·25 in. ; breadth 1 to 2 in. ; petiole 1·5 to 3 in. ; stipules lanceolate, villous externally, ·3 in. long. *Peduncles* as long as or longer than the leaves, slender, glabrous, bearing a solitary flower at the apex, or 2-branched and bearing 2 to 5 flowers ; bracts absent on the lower part of the peduncle, in pairs in its upper part, small, obovate-oblong. *Flowers* pink, their pedicels red. MALE ; *sepals* 2, oblong, blunt, ·15 in. long ; *petals* 2, similar but smaller ; *stamens* numerous ; *anthers* obovate, with emarginate apices, filaments short. FEMALES ; *perianth* of 4 unequal pieces, the outermost rotund-ovate : the inner oblong. *Styles* 3, thick, the stigmas large, flattened, rotund. *Capsule* 3-celled, opening on each face ; the wings subequal, spreading, triangular, blunt.

PERAK ; *Wray* 2476.—DISTRIB. Sumatra, *Forbes* 2666.

2. BEGONIA ISOPTERA, Dry. in Smith's Ic. 43. Caulescent : three feet high, nearly glabrous ; stem and branches slender. *Leaves* obliquely ovate-oblong or ovate-lanceolate, shortly acuminate, the base cordate, the sides very unequal ; edges remotely and usually coarsely dentate ; upper surface of leaves quite glabrous, the lower minutely scaly ; main-nerves mostly radiating from the base, branched, prominent ; length 3·5 to 6 in. ; breadth 1·5 to 3 in. ; petioles slender, varying from ·5 to

2·25 in. in length: *stipules* lanceolate or oblong, ·75 in. long. *Inflorescence* leaf-opposed, shorter than the leaves, slender; the female flowers near its base, the male on short branches on its upper half. MALES ·2 to ·3 in. across; *sepals* 2, rotund; petals 0; *stamens* numerous, broadly oblong or obovate, minutely apiculate; filaments short. FEMALE *perianth*-segments 5. *Styles* three, bifid, the arms twisted. *Capsule* 3-celled, about ·8 in. long and equally broad, dehiscing by two slits on each face, the three wings equal, narrow, oblong, ·25 in. wide. Dry. in Trans. Linn. Soc. I, 160. *B. repanda*, Bl. Enum. Pl. Jav. I, 97. *Diploclinium repandum*, Klo. Begon. 72. *Begonia Wrayi*, Hems. in Journ. Bot. for 1887, 203.

PERAK; *Scortechini* and *King's Collector*, many numbers. MALACCA; *Hervey*. SELANGOR; *Ridley* 8589. PAHANG; *Ridley* 2246. NEGRI SEMBALAN; *Ridley* 10028. PENANG; *Curtis* 7094.—DISTRIB. Sumatra, Java.

B. bombycina, Bl. (Enum. Pl. Jav. 97) is possibly identical with this; it has been reduced here by De Candolle and part of it is no doubt so reducible. Under *B. bombycina* however have been distributed specimens of an allied species with larger flowers in short spreading cymes. Which of the two plants Blume intended as his *B. bombycina*, it is impossible from his short description and in the absence of authentic specimens to determine.

3. BEGONIA ISOPTEROIDEA, King n. sp. Caulescent, 3 feet high, glabrous. *Leaves* thin, very obliquely ovate-lanceolate acuminate; the base acute on one side of the petiole but with a broad round auricle on the other, the edges remotely lobulate-dentate; lower surface with very minute white scales; main-nerves 7, radiating from the base, rather prominent beneath; length 3·5 to 4·5 in.; breadth 1·2 to 1·5 in.; petioles unequal, 2 to 3·5 in long. *Stipules* broadly lanceolate, acute, ·5 to ·75 in. long. *Peduncles* slender, axillary, about an inch long and bearing about two flowers on long slender pedicels and one sub-sessile. *Flowers* pink, large. MALES; *sepals* 2, rotund-oblong, blunt, ·75 in. long; *petals* 2 similar but only ·5 in. long; *stamens* inserted on an elongate anthophore, the anthers quadrate, 2-groved, truncate, only about half as long as the slender filaments. FEMALES nearly as large as the males; *style* short, thick, divided into 3 slender, bifid spiral spreading branches. *Capsules* about ·75 in. in length and breadth, 3-celled, its wings narrow oblong, thin, membranous, the posterior narrower than the lateral.

PERAK; on Gunong Brumban, elevation 5,000 feet; *Wray* 1548.

A species in leaves capsules and habit resembling *B. isoptera*, but with much larger flowers.

4. BEGONIA SINUATA, Wall. Cat. 3680. Shortly caulescent (from 2·5 to 12 inches high) the rootstock tuberous. *Leaves* either broadly

reniform and blunt, or sometimes with a short broad abrupt apiculus, the basal sinus deep and the edges wavy and minutely denticulate or crenate; or reniform-cordate, gradually tapered to the sub-acute apex, the margins slightly lobulate-dentate, the lobes denticulate, the basal sinus small: length of the reniform over 4 to 6 in.; breadth 5 to 8 in., of the ovate-reniform 1·5 to 3 in.; breadth 1 to 3 in.; petioles of the radical leaves 1 to 3 in.; of the cauline ·5 to 2·5 in.; both surfaces with numerous adpressed white stellate hairs, the lower with small oblong white scales also; main-nerves 7 to 11, radiating from the base, prominent on the lower surface; petioles unequal, ·5 to 3 in. long, pubescent. *Stipules* small, oblong-lanceolate, slightly oblique, blunt, glabrous. *Inflorescence* 3 to 8 inches long, sparsely stellate-puberulous; the peduncle very slender; branches few, short, filiform, few-flowered; bracts minute (·05 to ·1 in. long) bluntly lanceolate, rather densely adpressed-pubescent externally, the upper in whorls of three. *Flowers* small, pink, glabrous. Males about ·2 to ·25 in. in diam.: *sepals* 2, roundish; *petals* 2, narrower, obovate; *stamens* about 20, monadelphous; anthers obovoid, connective not produced. Female *perianth*-segments 5, the inner gradually smaller. *Styles* 2, combined for half their length, *stigmas* lunate. *Capsule* about ·3 in. broad and slightly longer, the posterior wing the largest. *Seeds* ovoid, shining, brown, deeply pitted. A. DC. Prod. XV, Pt. I, 354; Kurz in Journ. As. Soc. Beng., 1877, Pt. II, 108; Clarke in Hook. fil. Fl. Br. Ind. II, 650. *Diploclinium biloculare*, Wight Ic. 1814. *Begonia guttata, elongata* et *subrotunda*, Wall. Cat. 3671 B (*not* A), 6291, 6293.

Penang; *Wallich*; *Phillips*; *King's Collector* 2269, 4860; *Curtis* 390, 481, 3098; *Ridley* 9229. Malacca; *Maingay* (K.D.) 674. Perak; *King's Collector* 4971.—Distrib. Burma; *Griffith*, *Parish*.

5. Begonia andamensis, Parish ex Clarke in Hook. fil. Fl. Br. Ind. II, 650. Like the reniform-leaved form of *B. sinuata*, but the hairs on the surfaces of the leaves scanty: the inflorescence usually longer and its peduncle and branches much stouter; the bracts glabrous, longer (·35 to ·5 in.) and blunter and the male flowers (·5 in. across) and capsules (·6 in. across) longer and more numerous than those of *B. sinuata*.

Andaman Islands; *Parish*; *King's Collector*.—Distrib. Burma.

This ought probably to be regarded as a variety of *B. sinuata*. Actual specimens of the two look more different than written descriptions lead one to suppose; I therefore retain this as a species.

6. Begonia debilis, King n. sp. A slender weak herb, about 6 to 8 inches high, caulescent. *Leaves* thin, narrowly reniform, blunt or subacute; the base unequal, rounded at both sides but one auriculate and

much longer; edges sub-entire or slightly remotely and obscurely crenate; breadth 1·5 to 3 in.; length (from base of largest lobe to apex) 3·5 to 7 in.; upper surface glabrous, the lower minutely scaly; main-nerves 7, radiating from the base, some of them branching, rather prominent below; petioles 1 to 3 in. long. *Inflorescence* axillary or terminal, slender, longer than the leaves, with a few lax filiform dichotomous spreading few-flowered branches, bracts in pairs, ovate-lanceolate, ·1 to ·15 in. long. *Flowers* pure white, the stamens yellow. MALE ·35 in. across; *sepals* 2, oblong-ovate, blunt: *petals* 2, similar but smaller; *stamens* in a globular mass; anthers obovate, short with broad emarginate inappendiculate apices. FEMALE *perianth* of 5 unequal obliquely oblong pieces; *styles* united into a short column, above divided into numerous crowded awns. *Capsule* ·75 in. broad (to the end of the wings), and ·4 in. from base to apex, glabrous, 2-celled: the 2 lateral wings triangular, acute, the posterior wing oblong, tapering a little to the blunt apex, more than twice as long as the lateral.

PERAK; *King's Collector* 8289.

A species allied to *B. varians*, A. DC., but with more entire leaves.

7. BEGONIA THAIPINGENSIS, King n. sp. *Rhizome* long, creeping, rooting at intervals, wire-like, rusty-villous. *Leaves* rotund-reniform, the edges minutely and rather remotely dentate, the basal sinus mostly obliterated by the overlapping of the auricles; both surfaces scaly the lower more distinctly so and rusty tomentose on the 6 or 7 radiating sub-prominent nerves; length 1·25 to 2 in.; breadth 1·5 to 2·25 in.; petioles unequal, 1 to 4 in. long, densely rusty-tomentose. *Peduncles* 4 to 9 in. long, slender, sparsely rusty-villous, bearing one or two remote pairs of small lanceolate bracts and near the apex 3 to 5 slenderly pedicellate pink flowers on slender branches. MALE flowers; *sepals* 2, sub-rotund, ·15 in. long; *petals* 2, smaller, oblong; *stamens* numerous; *anthers* obovate, the apex blunt and emarginate, the filaments short. FEMALE *perianth* of 5 unequal pieces, the largest most external: *style* short, thick, with 2 stout arms and short thick twisted stigmas. *Capsule* 2-celled, ·5 in. broad (to the ends of the wings); all the wings triangular, sub-equal.

PERAK; *Scortechini* 1479; *Wray* 1774; *King's Collector* 2523, 8511.

A species allied to *B. sinuata*, Wall., but differing by the creeping rhizome, non-apiculate leaves, rusty-tomentose petioles and peduncles.

8. BEGONIA GUTTATA, Wall. Cat. 3671 A. *Stem* succulent, short. weak, bearing about two thin obliquely ovate-reniform glabrous nearly entire *leaves* with oblique cordate bases, and subacute apices; the nerves about 5, radiating from the base, prominent, sparsely hairy;

4 to 7 in. long and 2 to 4·5 in. broad; petioles 1·5 to 4 in. *Peduncles* varying in length from 1 to 2 in., slender, glabrous, bearing a few flowers near the apex. Male flower; *sepals* 2, rotund; petals 2, narrowly oblong; *stamens* about 50, monadelphous; *anthers* obovoid. Female; *perianth*-segments 5, gradually smaller inwards: *styles* 2, with two twisted branches. *Capsule* ·4 in. long and ·75 in. broad to the ends of the wings, the smaller wings very narrow; the posterior one broad, descending. A. DC., Prod. XV, Pt. I, 352; Clarke in Hook. fil. Fl. Br. Ind. II, 648.

Perak; *Scortechini* 571. Malacca; *Maingay* (Kew Distrib.) 675. Penang; *Wallich*. Selangor; *Ridley* 7289.

9. Begonia Hasskarlii, Zoll. et Mor. Syst. Verz. Zoll. 31 (*not of Miq.*) All parts glabrous. *Stem* a creeping rhizome. *Leaves* rotund-ovate, shortly and abruptly caudate-acuminate, peltate, the edges wavy but entire; both surfaces glabrous, the upper pitted when dry, the lower with sub-rotund scales; main-nerves about ten, radiating from the insertion of the petiole, not very prominent; length 3·5 to 5·5 in.; breadth 2·25 to 3·75 in.; petiole attached to the leaf about ·75 to 1·25 in. from its lower edge; *stipules* short, lanecolate. *Peduncle* usually longer than the leaves (often twice as long), about as thick as the petioles, bearing a few slender branches near the apex, ebracteate. *Flowers* small, white tipped with red. Male ·2 in. broad; *sepals* 2, reniform, the margins thick. *Stamens* numerous, cuneiform-oblong, their apices emarginate; filaments very short, free. Female, *sepals* 2, with vertical veins, reniform; *style* short, thick, with 4 short branches; *stigmas* 4, much lobulate. *Capsule* 4-celled, ·6 in. long, the lateral wings very narrow; the posterior broad slightly narrowed to the blunt apex, ·5 in. long: *seeds* minute, ovoid, tapering to one end, brown, shining, pitted. *B. peltata*, Hassk. in Hoev. et De Vriese, Tijdschr. X (1843) 133. *Metscherlicia coriacea*, Klotzsch in Abh. Akad. Berl. (1855) 74; Miq. Fl. Ind. Bat. I, Pt. I, 696. *B. coriacea*, Hassk. Pl. Jav. Rar. 209; *B. hernandiaefolia*, Hook. (not of others) Bot. Mag. t. 4676.

Perak; *Scortechini* 1607; *King's Collector* 4427. 8245; *Ridley* 9689. Pahang; *Ridley* 2442.—Distrib. Java, *Zollinger* 1613.

This is one of three species to which the specific name *peltata* has been given. That name must however be reserved for the Brazilian species to which it was first applied by Otto & Dietr. (Allg. Gartenz. IX (1841) 58). The MSS. name *B. Hasskarliana* was given by Miquel to a species near *B. coespitosa* which he confused with Zollinger's No. 1613 (the type of the species above described), and this inaccuracy was perpetuated by Miquel on p. 1091 of his Fl. Ind. Bat. I, Pt. I, where he describes *Diploclinium Hasskarlianum*.

10. Begonia Scortechinii, King, n. sp. *Rhizome* creeping, short, scaly.

Leaves on very long glabrous petioles, narrowly lanceolate, attenuate to the acuminate apex, and to the rounded or acute nearly equal-sided base; the edges dentate-ciliate; both surfaces with numerous scattered coarse subulate spreading hairs compressed at their bases, the lower also minutely scaly; main-nerves pinnate, 3 or 4 pairs, then ascending; length 2·75 to 4 in.; breadth ·5 to 1 in.; petioles 5 to 7 in. *Peduncles* axillary, somewhat shorter than the leaves, glabrous, bearing at the apex 2 few-flowered branches and a few rather long bracts. *Flowers* white, tinged with pink and green. MALE: *sepals* ovate, obtuse, ·75 in. long; *petals* narrower but nearly as long. *Stamens* numerous, in a short column; anthers linear-oblong, the apical appendage obtuse; filaments short. *Female* with perianth-segments similar to the male (*fide* Scortechini) but ·5. *Ovary* glabrous, 2-celled; *styles* free, 2 to 4-fid. *Capsule* ·75 in. broad (including the wings) the lateral wings narrow, oblong, the posterior much larger (*fide* Scortechini).

PERAK; *Scortechini* 1845; *King's Collector* 7227.

I have seen no ripe capsules, and the above description of them is taken from Scortechini's field-note. The species is readily distinguishable by its very narrow equal-sided coarsely hairy leaves. A drawing of this, sent to Herb. Kew from Penang by Mr. C. Curtis, represents the leaf-petioles as not more than one inch long.

11. BEGONIA KUNSTLERIANA, King n. sp. *Rhizome* creeping, very scaly. *Leaves* ovate-lanceolate to lanceolate, often but not always unequal-sided, much acuminate; the base cuneate usually oblique; edges ciliate-serrate, the teeth slightly unequal; both surfaces with coarse spreading hairs with dilated flattened bases; the lower with minute white scales also; main-nerves about 3 pairs, pinnate, densely rufescent villous like the petioles; length 5 to 7·5 in.; breadth 1·75 to 2·5 in.; petiole from half as long to nearly as long as the blade. *Peduncles* longer than the petioles and more slender, glabrous, 2- to 4-flowered at the apex. *Flowers* large, white, tinged with red. MALE; *sepals* 2, elliptic, obtuse, 1 in. long and ·5 in. broad, vertically veined; *petals* similar but not half so large. *Stamens* numerous, linear-oblong, bluntly apiculate. FEMALE *perianth* of 5 oblong blunt segments; *styles* 2, each with two short twisted branches. *Capsule* (to the end of the posterior wing) 1 in. broad: the lateral wings short, narrow; the posterior elongate not tapered to the apex, 2-celled. *Seeds* ellipsoid, shining, brown, pitted.

PERAK; *King's Collector* 7194; *Scortechini*; *Ridley* 9651.

This resembles *B. Scortechinii*, but has larger leaves and shorter petioles which are densely villous.

12. BEGONIA HERVEYANA, King n. sp. Glabrous except for a few

hairs on the nerves on the lower surface of the leaves: *rhizome* creeping, thin. *Leaves* broadly elliptic-ovate, shortly acuminate, slightly narrowed to the rounded almost equal-sided base; the edges slightly undulate, very indistinctly serrate; upper surface glabrous, lower very minutely scaly; nerves pinnate, about 6 pairs, ascending, branching; length 5 to 9 in.; breadth 3 to 4·5 in.; petioles much longer than the leaves, glabrous; *stipules* lanceolate, inconspicuous. *Peduncles* 5 to 10 in. long, slender, bearing near the apex 2 or 3 branches with few shortly pedicellate flowers. MALE *flowers; sepals* 2, ovate subrotund; *petals* 2, much smaller, oblong, blunt; *stamens* numerous, arranged in a cone, linear, with a blunt apical appendage, the filaments short. FEMALE *perianth* of 5 subrotund pieces. *Capsule* 1 in. broad and about half as much from base to apex, imperfectly 4-celled: lateral wings narrow oblong; the posterior wing ovate, blunt, about ·65 in. long.

MALACCA; *Hervey*; *Derry*.

This is a very distinct species resembling in the shape of its leaves no Asiatic *Begonia* that I have seen, except on unnamed species from Tonkin (No. 3763 of Herb. Balansa).

13. **BEGONIA PERAKENSIS**, King n. sp. *Rhizome* slender, creeping. *Leaves* ovate-lanceolate, slightly unequal-sided, acuminate; the base broad, rounded or very slightly emarginate or oblique, the edges obscurely and remotely dentate, or sub-entire; both surfaces glabrous, the lower minutely scaly; main-nerves pinnate, 4 or 5 pairs, ascending; length 3·5 to 5·5 in.; breadth 1·5 to 2·25 in.; petiole 2·5 to 5 in.; slender, glabrous. *Peduncles* usually longer than the leaves (at least when in fruit), 4-angled, glabrous, few-flowered. *Flowers* whitish tinged with pink, or pink. MALE; *sepals* rotund-ovate, ·4 in. long. *Petals* 2, oblong and much smaller. *Stamens* numerous, linear with short blunt apical appendages and short filaments. FEMALE *perianth* of 5 (?) segments. *Capsule* (ripe) 1·2 in. broad (to end of posterior wing), and ·5 in. from base to apex, 2-celled; the lateral wings oblong, narrow; the posterior oblong, blunt, slightly oblique, ·35 in. broad; *seeds* small, ellipsoid, pitted, shining.

PERAK; *King's Collector* 10338, 10506, 10951.

Specimens of a species closely resembling this, but insufficient for accurate determination, have been collected in Selangor by Mr. Ridley (Herb. Ridley 8590).

14. **BEGONIA PAUPERCULA**, King n. sp. *Rhizome* creeping, acaulescent, everywhere glabrous. *Leaves* ovate, very unequal-sided and very oblique at the base, or ovate-lanceolate, slightly unequal-sided and little oblique at the base; the apex always acuminate, the edges slightly sinuate-lobed, obscurely dentate; both surfaces glabrous: main-nerves 5 to 7, radiating from the base, prominent below, midrib with a few

lateral nerves, length 3·5 to 5 in.; breadth 1·25 to 3·5 in.; petioles varying in length from 2·5 to 7 in., slender, 2-to 3-flowered. *Flowers* white, tinged with red. MALES; *sepals* 2, elliptic-oblong, ·4 in. long; *petals* 0. *Stamens* linear-oblong, shortly and bluntly apiculate: filaments short. FEMALE; the *perianth* of 5 very unequal lobes, the outermost larger than the sepals of the male. *Capsules* ·6 in. long and 1 in. broad, 2-celled; the 2 lateral wings sub-elliptic, oblique, ·3 in. broad; the posterior wing oblong, blunt, ·6 to ·7 in long and ·35 in. broad.

PERAK; *King's Collector* 5952.

This has leaves resembling those of *B. borneensis*, but the flowers are fewer and larger. Beccari's Sumatra specimens (P.S. 857), in fruit only, appear to belong to this species.

15. BEGONIA VENUSTA, King n. sp. *Rhizome* slender, creeping; whole plant glabrous. *Leaves* reniformly ovate, shortly acuminate, the basal sinus deep; the edges sub-entire or remotely and minutely denticulate; both surfaces smooth, shining: main-nerves 7, radiating from the base, slender; length 3 to 5·5 in.; breadth 2 to 3·5 in.; petioles unequal, slender, from 6 to 12 in. in length. *Peduncles* 3·5 to 6 in. long, bearing about 3 pedunculate pinkish-white flowers near the apex. MALE; *sepals* 2, ovate-rotund, blunt, ·75 in. long. *Petals* 2, somewhat larger. *Stamens* narrowly oblong, with a large apiculus; filaments unequal, the inner ones long, the outer short. FEMALES smaller than the male, the *perianth* of 5 unequal broad blunt segments; *styles* very short, with numerous broad depressed lobules. *Capsule* ·3 in. long and 1·15 in. broad (to the ends of the wings); lateral wings more than half as long as the posterior, broadly triangular, blunt; posterior wing oblong, blunt, ·7 in. long.

PERAK; at an elevation of about 6,000 ft., *Wray* 1598.

The leaves are not unlike those of *B. paupercula* and *B. borneensis* but the flowers are large and handsome.

16. BEGONIA MEGAPTEROIDEA, King n. sp. *Rhizome* as thick as a swan-quill, creeping on rocks. *Leaves* broadly and very obliquely ovate, acuminate; both sides of the base rounded but very unequal, the sinus between them wide, the edges remotely and minutely dentate, upper surface glabrous; the lower also glabrous except the rusty-pubescent nerves which are also scaly near the base: main-nerves about 8, radiating from the base, the larger branched and all rather prominent; length (from apex of petiole to apex of blade) 4 to 5 in.; breadth 4 to 5 in.; petiole 12 to 16 in. long, glabrous. *Peduncles* from half as long to nearly as long as the leaves, glabrous, ebracteate below the flowers. MALE flowers: *sepals* rotund-ovate, very obtuse, 1 in. long and ·6 to ·7 in. broad; *petals* much smaller, elliptic: *stamens* numerous, in a conical

mass on a short thick anthophore; *anthers* oblong, bluntly apiculate, filaments varying in length (the inner the longest). FEMALE *perianth* of 5 unequal pieces: *styles* 2, rather long, combined at the base. *Capsule* not seen.

PERAK; collected at an elevation of 5,000 ft., *Wray* 1450, 1573.

Specimens of this plant are rather scanty. They resemble *B. megaptera*, but are not caulescent like that species. In the Calcutta Herbarium there is, under the name *Diploclinium tuberosum*, Miq., a specimen collected by Kurz in Western Java which apparently belongs to this species. There are also two plants from Sumatra collected by Forbes (Herb. Forbes 2333*a* and 2255) which appear to belong to this. The genus *Diploclinium* is inseparable from *Begonia* and the specific name *tuberosa* is pre-occupied in the latter by a species described by Lamack from the Moluccas which has a rounded tuberous root.

17. BEGONIA MAXWELLIANA, King n. sp. *Rhizome* as thick as a swan-quill, bearing many broadly lanceolate scales. *Leaves* broadly and obliquely ovate to ovate-rotund, more or less acuminate, the edges minutely ciliate-denticulate, the base very oblique, one side of it rounded the other rounded-auriculate, the sinus wide; both surfaces with a few coarse compressed rusty hairs, most numerous on the nerves near the base; the lower surface with minute white scales; main-nerves 7 to 9, radiating from the base, prominent; length 5 to 6 in.; breadth 4 to 7 in.; petioles 4 to 10 in. long, compresed (when dry) like the peduncles and like them rusty-pubescent. *Peduncles* unequal, those bearing only male flowers often shorter than the petioles; those bearing female and male, or females only often longer than the petioles; all ebracteate below the inflorescence, dichotomously branched and few-flowered at the apex; the bracts short, broad. MALE flowers densely clustered; *sepals* 2, oblong-ovate, blunt, ·4 in. long, puberulous outside; *petals* 2, similar, but much smaller. *Stamens* numerous, without anthophore; anthers linear, bluntly apiculate, slightly shorter than the filaments. FEMALE *perianth* of 5 unequal pieces diminishing in size inwards; *styles* 2, short, much lobulate. *Capsule* 2-celled, 1·4 in. broad (to the ends of the wings) and ·6 in from base to apex; the 2 lateral wings sub-quadrate, obtuse; the posterior oblong, blunt, more than three times as long as the lateral.

PERAK; Maxwell's Hill, at elevation of 3,000 feet, *Wray* 119, 2199; *Scortechini* 1607, 1798; *King's Collector* 2038.—DISTRIB. Sumatra, *Forbes* 3119*a*.

The flowers of this are white tinged with pink and the leaves green, the nerves beneath being red. This resembles B. *megapteroidea*, King, but the flowers are smaller, and the leaves and inflorescence are not glabrous as in that species.

18. BEGONIA PRÆCLARA, King n. sp. *Rhizome* creeping, very scaly. *Leaves* obliquely ovate, acuminate, the base rounded on one side of the

petiole and on the other expanding into a broad rounded auricle, the edges minutely dentate, rarely with small lobes besides: upper surface with numerous conical papillæ each bearing a coarse curved hair, flattened at the base; under surface with a few scattered flattened hairs especially on the nerves; main-nerves 7, radiating from the base, prominent beneath; length 3·5 to 5·5 in.; breadth 2·5 to 3·5 in.; petioles unequal 3 to 6 in. long, with a few flexuose hairs near the apex. *Peduncles* longer than the petioles, slender, glabrous, 1- to 3-flowered. *Flowers* on rather long slender pedicels, pink. MALES; *sepals* 2, narrowly oblong-ovate, obtuse, ·8 in. long; *petals* 2, narrowly oblong, blunt, ·5 in. long; *stamens* linear-oblong, apiculate, the filaments unequal the central the largest. FEMALE perianth unknown; ~~*styles*~~ 2, short, 2-branched, branches divided into many flat twisted lobes. *Capsule* ·5 in. long and about 1·5 in. broad (to the ends of the wings); the lateral wings quadrate-ovate, obtuse, about ·4 in. long; the posterior oblong, blunt, 1 in. long and ·4 in. broad.

PERAK; at elevations of from 3,000 to 6,700 feet, *Wray* 318, 349, 427; *King's Collector* 8077.

The upper surface of the leaves is dark green, the nerves being coloured; the under surface is red of various tints and the flower-stalks are pale crimson.

19. BEGONIA LOWIANA, King n. sp. Caulescent; 3 feet high; stems and branches covered with coarse flexuose glandular hairs. *Leaves* mostly very obliquely reniform; but some of the cauline ovate and nearly equal-sided acute, the basal sinus deep, the edges with a few very shallow lobes closely and rather minutely dentate-serrate and shortly ciliate; both surfaces coarsely rusty-pubescent, the hairs flexuose compressed and with dilated bases, the lower also with small white scales; main-nerves about 9, radiating from the base, prominent and densely villous; length 3 to 4·5 in.; breadth 4 to 7 in.; petioles unequal, stout, villous like the under surface of the ribs and midrib, from ·4 in. long in the upper leaves, to 4 in. long in the lower. *Cymes* few-flowered, leaf-opposed and terminal, shorter than the leaves when in flower, much larger when in fruit; bracts ovate-lanceolate, opposite, ciliate. *Flowers* pink or white, pedicellate. MALE about ·75 in. across; *sepals* 2, ovate-oblong, sub-acute, ·5 in. long; *petals* 2, oblong, much smaller. *Stamens* numerous, oblong, blunt, without apical appendages; filaments short. FEMALE, the *perianth* of 5 pieces decreasing in size inwards; *styles* 2, deeply bifid and spiral. *Capsules* ·65 in. long and twice as broad to the end of the wings; lateral wings very narrow (about ·15 in. broad), the posterior oblique, broadly ovate, blunt, ·9 in. long and ·8 in. broad.

PERAK; at an elevation of 7,000 feet on Gunong Brumber Pahang, *Wray* 1567; also on Gunong Batu Puleh, *Wray* 316.

This resembles the Indian species *B. Thomsonii*, DC., but differs in being caulescent, in having shorter hairs on leaves and petioles, and in the posterior wing of the capsule being much larger. I have named the species after Sir Hugh Low, late British resident at Malacca, to commemorate his many services towards the botanical exploration of the Province of Perak.

Order LIV. FICOIDEÆ.

Herbs. *Leaves* simple, often fleshy, usually opposite or whorled; stipules 0 or scarious. *Flowers* usually in cymes or clusters, rarely solitary, regular, hermaphrodite rarely polygamous. *Calyx* of 4-5 segments, united into a tube or nearly distinct, free from the ovary in the Indian genera, often persistent. *Petals* usually wanting, when present small. *Stamens* perigynous or hypogynous, definite or indefinite; staminodes sometimes present. *Ovary* free (except in *Mesembryanthemum*), 2-5-celled, syncarpous (except in *Gisekia*); styles as many as the carpels: ovules numerous in each carpel and axile or solitary and basal. *Fruit* usually capsular, splitting dorsally or circumsciss, more rarely the carpels separate into cocci. *Seeds* many or 1 in each carpel, usually reniform, compressed; embryo curved or annular, surrounding the farinaceous albumen, radicle next the hilum.—DISTRIB. Species 450, chiefly African, a few are scattered through most tropical and subtropical regions.

Capsule with circumscissile dehiscence ... ... 1. SESUVIUM.
Capsule with dorsal dehiscence ... ... 2. MOLLUGO.

1. SESUVIUM, Linn.

Succulent branching herbs. *Leaves* opposite, fleshy; stipules 0. *Flowers* axillary, sessile or peduncled, solitary, rarely in cymes. *Calyx-tube* short; lobes 5, triangular-lanceolate, persistent, often coloured. *Petals* 0. *Stamens* many or 5, inserted round the summit of the calyx-tube. *Ovary* free, 3-5-celled; styles 3-5; ovules many, axile. *Capsule* ovate-oblong, membranous, 3-5-celled, circumsciss. *Seeds* many in each cell, reniform; embryo annular.—DISTRIB. Species 4, littoral in warm climates.

SESUVIUM PORTULACASTRUM, Linn. Syst. ed. 10, 1058. Creeping and rooting in the sand, glabrous. *Leaves* linear-spathulate almost cylindric, sometimes sub-obovate: gradually narrowed into a short petiole with dilated scariously margined base. *Flowers* solitary, axillary, their pedicels ·25 in. long. *Calyx* rose-coloured inside. *Stamens* 15 to 40, free or almost free. *Styles* 3 to 5. *Capsule* ·2 in. across. *Seeds* black, shining, smooth, not numerous. Roxb. Fl. Ind. II, 509; Dalz. & Gibs. Bomb.

Fl. 15; Kurz in Journ. As. Soc. Beng. 1877, Pt. II, 110: Clarke in Hook. fil. Fl. Br. Ind. II, 659. *S. repens*, Willd. Enum. p. 511; DC. Prod. III, 453: W. & A. Prod. Fl. Pen. Ind. 361; Wight in Hook. Comp. Bot. Mag. II, 71, t. 23; Miq. Fl. Ind. Bat. I, Pt. I, 1060. *Psammanthe marina*, Hance in Walp. Ann. II, 660. *Crithmum indicum*, Rumph. Herb. Amb. VI, t. 72, fig. 1.

On the sea shores in the Andamans and the other Provinces.—Distrib. B. India, Malayan Archipelago.

2. Mollugo, Linn.

Herbs, branched, often dichotomous. *Leaves* often falsely whorled, or alternate, or all radical, from linear to obovate, entire; stipules fugacious. *Flowers* axillary, sessile or pedicelled, clustered or in panicles or racemes, small, greenish; bracts inconspicuous. *Sepals* 5, persistent. *Petals* 0; staminodes 0 or small in the same species. *Stamens* 5-3, rarely many. *Ovary* free, globose or ellipsoid, 3-5-celled; styles 3-5, linear or very small; ovules many, axile. *Capsule* membranous, sheathed by the sepals, 3-5-celled, dehiscing dorsally. *Seeds* several in each cell, rarely 1, reniform, appendaged or not at the hilum; embryo annular.—Distrib. Species 12, tropical and subtropical.

Mollugo pentaphylla, Linn. Spec. Plantar. ed. 1 (1753), 89. A few inches high, glabrous; stems much-branched, leafy, varying from oblong-lanceolate, lanceolate-acute to obovate-obtuse, contracted at the base, subsessile or sessile, from less than ·5 in. to more than 2 in. in length. *Panicles* compound, terminal, many times longer than the leaves. *Sepals* elliptic or rotund, blunt. *Stamens* 3 to 5, short; filaments rather broad, compressed. *Capsule* globose, as long as the sepals, thin-walled, many seeded. *Seeds* dark-brown, tubercled; embryo curved. W. & A. Prodr. 44; Dalz. & Gibs. Bomb. Fl. 16; Kurz in Journ. As. Soc. 1877, Part II, 111. *M. triphylla*, Lour. Fl. Cochinc. 79; DC. Prodr. I, 392; Roxb. Hort. Beng. 9, Fl. Ind. I, 360; Wall. Cat. 651; W. & A. Prodr. 44. *M. Linkii*, Seringe in DC. l.c. *M. stricta*, Linn. Sp. Pl. ed. II, 131; DC. Prodr. I, 391; Roxb. l.c.; Wall. Cat. 650; W. & A. Prodr. 44; Dalz. & Gibs. l.c.; Clarke in Hook. fil. Fl. Br. Ind. II, 663: *Pharnaceum strictum*, *triphyllum* and *pentaphyllum*, Spreng. Syst. I, 949.—Rheede Hort. Mal. x. t. 26.

In all the Provinces, near cultivated places.—Distrib. General throughout S. E. Asia.

Order LV. UMBELLIFERÆ.

Herbs (rarely in non-Indian species shrubs or trees). *Leaves* alternate, usually divided or dissected, sometimes simple, petiole generally sheathing at the base; stipules 0. *Flowers* hermaphrodite or polygamous, in compound umbels (simple in *Hydrocotyle* and *Bupleurum*), exterior of the umbel sometimes radiant; umbels with involucriform bracts at the base of the general one and bracteoles at the base of the partial ones (umbellules). *Calyx-tube* adnate to the ovary, limb 0 or 5-toothed. *Petals* 5, epigynous, often unequal, and with a median fold on the face, plane or emarginate or 2-lobed with the apex inflexed; imbricated in bud, in *Hydrocotyle* sometimes valvate. *Stamens* 5, epigynous. *Ovary* inferior, 2-celled, disc 2-lobed; styles 2, stigmas capitellate; ovules 1 in each cell, pendulous. *Fruit* of 2 indehiscent dorsally or laterally compressed carpels, separated by a commissure; carpels each attached to and often pendulous from a slender often forked axis (carpophore), with 5 primary ridges (1 dorsal, 2 marginal and 2 intermediate) and often 4 secondary ones intercalated between these; pericarp often traversed by oil-canals (vittæ). *Seed* 1 in each carpel, pendulous, albumen cartilaginous; embryo small, next the hilum, radicle superior.—DISTRIB. Species about 1,500, mainly in Europe, North Africa, West Central and North Asia; a few are North American, tropical, and natives of the Southern Hemisphere.

Creeping unarmed herbs ... ... 1. HYDROCOTYLE.
Erect spinous herbs ... ... 2. ERYNGIUM.

1. HYDROCOTYLE, Linn.

Prostrate herbs, rooting at the nodes. *Leaves* (in the Indian species) cordate or hastate, not peltate, round or 5–9-gonal, subentire or palmately lobed, palmate-nerved, long-petioled; stipules small, scarious. *Umbels* (in the Indian species) simple, small; bracts small or 0; flowers white, sometimes unisexual. *Calyx-teeth* 0 or minute. *Petals* entire, valvate or imbricate. *Fruit* laterally compressed, commissure narrow; carpels laterally compressed or sub-pentagonal; lateral primary ridges concealed within the commissure, or distant therefrom and prominent; vittæ 0, or most slender, obscure; carpophore 0. *Seed* laterally compressed.—DISTRIB. Species 70; in wet places in tropical and temperate regions, more numerous in the Southern Hemisphere.

Petals acute, valvate; fruit with no secondary ridges; pericarp thin ... ... 1. *H. javanica.*
Petals obtuse, imbricate; fruit with prominent secondary ridges, the pericarp thickened ... ... 2. *H. asiatica.*

1. HYDROCOTYLE JAVANICA, Thunb. Dissert. Hydrocot. n. 17, t. 2: ed. Pers. II, 415, t. 2. *Leaves* reniform, 5–6-lobed, the lobes irregularly crenate, sometimes sub-entire, 1 to 3 in. broad. *Peduncles* long, slender, often clustered. *Petals* acute, valvate. *Fruit* much compressed, the

secondary ridges absent; pericarp thin, blackish. DC. Prodr. IV. 67; Miq. Fl. Ind. Bat. I. Pt. I, 734; Kurz in Journ. As. Soc. 1877, Pt. II. 113; Clarke in Hook fil. Fl. Br. Ind. II, 667. *H. hispida*, Don Prodr. 183. *H. nepalensis*, Hook. Exot. Fl. t. 30; Wall. Cat. 561; DC. l.c. 65; Miq. l.c. 735. *H. zeylanica*, DC. l.c. 67; W. & A. Prodr. 366; Miq. l.c. 734. *H. hirsuta*, Blume Bijd. 884. *H. polycephala*, W. & A. Prodr. 366; Wight. Ic. t. 1003. *H. hirta*, R. Br. var. *acutiloba*, F. Muell.; Benth. Fl. Austral. III. 340. *H. Heyneana*, Wall. Cat. 563. *H. strigosa*, Ham. in Wall. Cat. 7219.

PERAK; and probably in all the other provinces except the Andaman and Nicobar Islands.—DISTRIB. The Malay Archipelago, Australia, Philippines.

2. HYDROCOTYLE ASIATICA, Linn. Sp. Pl. 234. *Leaves* rotund-reniform, the margins not lobed but uniformly crenate or dentate, sometimes sub-entire, ·5 to 2 in. broad. *Peduncles* short, often 2 or 3 together. *Petals* obtuse, imbricate. *Fruit* compressed, secondary ridges prominent, pericarp thickened. Roxb. Hort. Beng. 31: Fl. Ind. II, 88; Wall. Cat. 560; DC. Prodr. IV, 62; W. & A. Prodr. 366; Wight Ic. t. 565; Dalz. & Gibs. Bomb. Fl. 105; Kurz in Journ. As. Soc. 1877, Pt. II, 113; Clarke in Hook. fil. Fl. Br. Ind. II, 669. *H. Wightiana*, Wall. Cat. 7220. *H. lurida*, Hance in Walp. Ann. II, 690.—Rheede Hort. Mal. X. t. 46.

ANDAMAN ISLANDS; PERAK.—DISTRIB. Tropical and sub-tropical regions.

2. ERYNGIUM, Linn.

Spinescent, glabrous, erect, perennial *herbs* (the Indian species). *Leaves* spinous-toothed, entire lobed or dissected. *Flowers* in simple heads, each bracteolate; bracts whorled, spinulose (in Indian species). *Calyx-tube* covered with ascending hyaline scales; teeth rigid, acute. *Petals* whitish, narrow, erect, emarginate, scarcely imbricate. *Fruit* ellipsoid, nearly cylindric: carpels dorsally subcompressed, subconcave on the inner face; primary ridges obtuse not prominent, secondary 0; vittæ in the primary ridges inconspicuous or 0, with some very slender scattered in the endocarp: carpophore 0. *Seed* semi-terete, dorsally subcompressed, subconcave on the inner face.—DISTRIB. Species 100, temperate and tropical; plentiful in Western Asia.

ERYNGIUM FŒTIDUM, Linn. Sp. Pl. 232, (*in part.*) Erect, unbranched below, dichotomously branched above. *Leaves* radical, oblong-oblanceolate, coarsely serrate, glabrous, 4 to 9 in. long and not more than 1 in. broad. *Bracts* of inflorescence all spinous-toothed; the lower deeply lobed; the upper smaller (about 1 in. long), lanceolate, not lobed, whorled. *Flowers* in dense cylindric spikes, less than 1 in. long DC. Prodr. IV, 94.

SINGAPORE: *King's Collector* 333.

Order LVII. CORNACEÆ.

Shrubs or trees. *Leaves* opposite or alternate, more or less coriaceous, usually petiolate, entire, rarely serrate or lobed, often unequal at the base, exstipulate. *Flowers* usually small, regular, hermaphrodite or unisexual, in axillary or terminal cymes, panicles or capitules. *Calyx-tube* adherent to the ovary; the limb truncate or 4–5-toothed or lobed, valvate or imbricate, persistent at the apex of the fruit. ~~*Petals*~~ 4-5, sometimes as many as 20, or none, valvate or imbricate. *Stamens* inserted with the petals and equal to them in number, rarely 2 or 3 times as many. *Ovary* inferior, 1–4-celled, crowned by a large fleshy or rarely small disc. *Style* single, long or short; stigma truncate, capitate or pyramidal, sometimes lobed. *Ovules* solitary in each cell (rarely 2), pendulous from the apex. *Fruit* baccate, (the pulp often scanty), usually 1-celled, sometimes as many as 4-celled. *Seed* oblong, pendulous, with copious fleshy albumen; embryo axile minute or often large with flat leafy cotyledons.—DISTRIB. Species about 90, widely scattered but most abundant in the temperate regions of the Northern Hemisphere.

Flowers hermaphrodite:—
  Petals not larger than the lobes of the calyx; anthers short, ovate and cordate; style short ... ... 1. MASTIXIA.
  Petals much longer than the lobes of the calyx; anthers long, linear; style elongate ... ... 2. ALANGIUM.
Flowers unisexual ... ... 3. NYSSA.

1. MASTIXIA, Blume.

Trees, young parts more or less pubescent. *Leaves* alternate or opposite, petioled, entire. *Flowers* hermaphrodite, often 2-bracteolate, small, in terminal many-flowered cymose panicles; bracts small or lengthened, pedicels short or 0, jointed under the flower. *Calyx-tube* campanulate, pubescent or silky; limb 5–4-toothed. *Petals* 5–4, ovate, leathery, valvate, pubescent, silky. *Stamens* 5–4; anthers cordate-oblong. *Ovary* 1-celled; disc fleshy; style cylindric, simple; ovule 1, pendulous from one side of the cell very near its summit. *Drupe* ellipsoid or ovoid, crowned by the calyx-teeth or a scar; putamen grooved down one face; endocarp protruded inwards down one side. *Seed* ellipsoid; albumen fleshy; embryo small, radicle elongate, cotyledons thin, elliptic.—DISTRIB. Species 18; S. India and Malaya.

Leaves alternate; bracts of the inflorescence dimorphous ... 1. *M. bracteata.*
Leaves alternate or opposite :—
  Bracts of the inflorescence all small, triangular, concave, puberulous, not in whorls ... ... 2. *M. Scortechinii.*
  Bracts of inflorescence in whorls at the base of the flower-pedicels, broad ... ... 3. *M. gracilis.*
Leaves opposite :—
  Flowers 5-merous ... ... 4. *M. Maingayi.*
  Flowers 4-merous ... ... 5. *M. Clarkeana.*

1. Mastixia bracteata, Clarke in Hook. fil. Fl. Br. Ind. II, 746. A tree 40 or 50 feet high: young branches slender, glabrous. *Leaves* alternate, thinly coriaceous, olivaceous-green when dry, abruptly bluntly and shortly acuminate, the base cuneate; both surfaces glabrous, the lower faintly reticulate; main-nerves 5 or 6 pairs, ascending, curved, impressed on the upper but prominent on the lower surface: length 1·75 to 3 in.; breadth ·75 to 1·35 in.; petiole ·25 to ·5 in. *Cymes* terminal, ·75 to 1·5 in. long, branching, many-flowered, bracteate; the bracts of two sorts; those at the bases of the branches linear-oblong, blunt, 1-nerved, glabrous, longer than the flowers; those at the bases of the flowers much smaller, lanceolate, puberulous. *Flowers* a little over ·1 in. long. *Calyx* funnel-shaped, the tube adpressed-silky outside; the mouth expanded, glabrous, wavy but scarcely distinctly toothed, *Corolla* hemispheric in bud: *petals* adnate by their edges, broadly ovate, silky externally. *Anthers* 5, broadly ovate, cordate at the base; filaments short. *Disc* large, fleshy, 5-toothed, each tooth with an oblong depression in the middle. *Style* short, grooved. *Fruit* unknown.

Malacca: *Maingay* (K.D.) 710. Perak: *Kunstler* 6830.

2. Mastixia Scortechinii, King n. sp. A small tree; young branches slender, angled, glabrous. *Leaves* coriaceous, elliptic-oblong or oblanceolate, much attenuate to the base, the apex shortly and bluntly acuminate; both surfaces glabrous, pale olivaceous when dry, the lower the palest; main-nerves 4 or 5 pairs, ascending, slender; length 1·75 to 2·5 in.; breadth ·85 to 1·25 in.; petiole ·25 to ·5 in. *Cymes* corymbose, terminal, several together, 1·25 to 1·75 in. long, puberulous; the branches short, angled; bracts at the bases of the branches and of the flowers similar, small, triangular, concave, puberulous. *Flowers* sessile; *calyx-tube* narrowly campanulate, the mouth with 5 distinct triangular teeth. *Corolla* depressed-globose in bud. *Petals* 5, puberulous outside, ovate, acute. *Stamens* 5: *anthers* broadly ovate, cordate at the base: filaments short. *Disc* fleshy, cushion-like, with 5 short lobes. *Ovary* 1-celled; *style* short, grooved, stigma peltate. *Fruit* unknown. *M. bracteata* Scortechini MSS. (not of Clarke).

Perak: *Scortechini* 1971.

This much resembles a leaf specimen issued by Koorders and Valeton (No. 914) from Herb. Buitenzorg as *M. trichotoma*, Bl. I have not seen Blume's type of this species. But in his Bijdragen he describes its flowers as tetramerous. A Sumatra specimen collected by Beccari (P.S. 956) which has ripe fruit but no flowers probably belong to this. These fruits are narrowly oblong, tapering to each end, smooth, slightly over an inch in length and about ·35 in. in diam. (when dry). *M. Scortechinii* much resembles *M. bracteata*, Clarke; but differs in having bold acute calyx-teeth, and only one kind of bracts on the inflorescence.

3. MASTIXIA GRACILIS, King n. sp. A small tree; young branches slender, angled, smooth, yellowish. *Leaves* thinly coriaceous, lanceolate, tapering much to the base and still more to the much acuminate apex; both surfaces pale olivaceous-green when dry, glabrous; the upper shining, the lower somewhat dull; main-nerves 8 to 14 pairs, ascending, very little curved, faint on both surfaces; length 2·25 to 4·5 in.; breadth ·8 to 1·5 in.; petioles varying from ·2 to ·25 in. *Cymes* in threes, terminal, about a third or a fourth the length of the leaves, on short angled peduncles, the branches short and crowded at their apices, many-flowered, with a whorl of minute broad bracts at the base of flower pedicels. *Flowers* about ·1 in. long, their pedicels about as long, ovoid. *Calyx* campanulate; the tube puberulous, slightly furrowed; the mouth wavy, indistinctly 5-toothed. *Petals* 5, oblong-ovate, adherent by their edges, concave, leathery. *Stamens* 5; *anthers* oblong, bifid: filaments short. *Disc* small. *Style* short, conical: stigma concave. *Fruit* unknown.

PERAK: at an elevation of about 5,000 feet; *Wray* 1528.

4. MASTIXIA MAINGAYI, Clarke in Hook. fil. Fl. Br. Ind. II, 746. A tall tree; young branches, petioles, under surfaces of leaves, branches and bracts of the inflorescence and the outer surfaces of the calyx and petals densely and softly rusty-tomentose. *Leaves* opposite, coriaceous, elliptic or elliptic-ovate, the apex shortly and abruptly acuminate, the base cuneate; upper surface glabrous, greenish when dry, the midrib and nerves impressed; the tomentum on the lower surface pale brown; main-nerves 6 to 8 pairs, ascending, curved, very prominent on the lower surface and connecting nerves transverse; length 4 to 6 in.; breadth 1·5 to 3 in.; petioles unequal, ·75 to 1 in. *Cymes* branched, on peduncles 1·5 to 2 in. long, terminal, longer than the leaves; the bracts at the bases of the branches small, oblong. *Flowers* numerous, ·15 in. long. *Calyx* campanulate, deeply 4-lobed; the lobes broadly ovate, obtuse. *Petals* 4, similar in shape to the sepals but smaller, concave, adnate by their edges. *Stamens* 4, inserted on a thick fleshy cushion-like circular disc by short filaments; *anthers* short, broadly ovate, cordate, introrse. *Ovary* one-celled, crowned by the fleshy disc. *Fruit* ellipsaid, not compressed, attenuate towards the apex, smooth, 1·2 in. long and ·6 in. in diam.

MALACCA: *Maingay* (K.D.) 711. SINGAPORE: *T. Anderson, Kurz.*

VAR. *sub-tomentosa*, King. The tomentum minute, the *panicles* somewhat shorter, otherwise as in the typical form. *M. Junghuhniana*, Clarke not of Miq. in Hook. fil. Fl. Br. Ind. II, 746.

SINGAPORE: *Ridley* 6293, 6310. PENANG: *Curtis* 1564. MALACCA: *Maingay* (K.D.) 709.

5. MASTIXIA CLARKEANA, King n. sp. A tree 40 to 60 feet high; young branches slender, striate, glabrous. *Leaves* opposite, thinly coriaceous, oblong or oblong-lanceolate, narrowed to the rounded or sub-acute base; the apex rather abruptly and somewhat bluntly acuminate; both surfaces glabrous, the upper pale olivaceous-green, the lower dull, pale brownish when dry; main-nerves 5 to 6 or 7 pairs, ascending, slightly curved, impressed on the upper surface, prominent on the lower; length 3 to 4 in.; breadth 1 to 1·35 in.; petiole ·3 to ·35 in. *Cymes* terminal, nearly as long as (or sometimes longer than) the leaves, pedunculate, with rather numerous many-flowered angular puberulous branches: bracteoles minute, opposite in pairs, lanceolate or ovate, concave. *Flowers* ·1 in. long, sessile. *Calyx* funnel-shaped, pubescent outside, the mouth with 4 deep broadly ovate teeth. *Corolla* depressed-globular in bud. *Petals* 4, nearly as long as the calyx-teeth, ovate-rotund, concave. *Stamens* 4: anthers short, ovate-rotund, filaments short. *Disc* fleshy, 4-lobed. *Style* short, compressed. *Stigma* concave. *Fruit* unknown.

PERAK: *Scortechini* 98, 625, 869; *King's Collector* 10861.

VAR. *macrophylla*, King. *Leaves* ovate-elliptic, shortly acuminate; main nerves 7 pairs: flowers as in the typical form.

PERAK: *Scortechini* 10575.

There are in Herb. Cal. specimens belonging to four distinct species of *Mastixa* which are too imperfect to be named, and which I have been unable to match with any already described species. These are as follows:—

(*a*). Two gatherings (*Wray* 1234 and *King's Collector* 2907) of a plant collected at an elevation of from 3000 to 3400 feet in Perak which is evidently a *Mastixia*. In their leaves these resemble *M. Maingayi*, Clarke, var. *sub-tomentosa*, King; but the under surfaces are more glabrous and the main-nerves are rather more oblique than in that plant; the young branches are moreover of a dark colour and almost glabrous, while those of *M. Maingayi* are pale and rufescently tomentose. These specimens are in fruit, and none of them has a single flower. The fruit is narrowly ellipsoid, attenuate gradually to the apex, smooth, 1·2 in. long, and ·4 in. in diam. While the leaves suggest a relationship to *M. Maingayi*, the remains of the calyx-lobes at the apex of the fruit, which are 4-lobed, suggest perhaps a still closer affinity to the tetramerous species *M. Clarkeana*, King.

(*b*). A specimen from Penang (Herb. *Curtis* 919) which is in fruit only.

(*c*). Specimens of a tetramerous species (in fruit only) from the Andamans with leaves otherwise like those of *M. pentandra*, Bl., but obscurely serrate.

(*d*). Two specimens collected by Mr. Wray at an elevation of 6,700 feet in Perak. These are in fruit; their leaves resemble those of *M. gracilis*, King but have the main-nerves fewer but bolder.

2. ALANGIUM, Lamk.

Shrubs or trees. *Leaves* alternate, petiolate, entire, persistent. *Flowers* in axillary fascicles or short cymes, hermaphrodite, hairy, jointed on their pedicels; bracts small or 0. *Calyx-tube* adnate to the ovary, the limb toothed or truncate. *Petals* 5 or 6 (rarely more), linear-oblong, valvate, sometimes becoming reflexed. *Stamens* equal in number to or twice as many as the petals or more; the anthers, long, linear; the filaments short compressed, often hairy. *Ovary* inferior, 1- to 3-celled, or 1-celled at the apex and 2- to 3-celled at the base, surmounted by a fleshy disc: *style* very long often clavate; *stigma* large, capitate or pyramidal; *ovule* pendulous. *Fruit* a berry, often with very scanty pulp, crowned by the slightly enlarged calyx. *Seed* oblong, compressed; albumen fleshy, sometimes ruminate; cotyledons leafy, flat or crumpled: radicle long or short.—DISTRIB. About 16 species, in tropical and sub-tropical Asia and Africa, Australia, Polynesia.

Stamens (in Malayan specimens) more than 6 (usually 15 to 20): fruit only slightly compressed	1. *A. Lamarckii.*
Stamens 5 or 6; fruit much compressed:—	
Leaves oblique, membranous:—	
Cymes on comparatively long peduncles, much-branched, many-flowered	2. *A. uniloculare.*
Leaves not oblique, coriaceous:—	
Cymes on short peduncles; flowers 6 to 12, shortly pedicelled and ·1 in. in diam.; leaves glabrous above and minutely scaly underneath	3. *A. ebenaceum.*
Cymes sessile, 3- to 5-flowered; flowers ·25 in. in diam.; leaves glabrous on both surfaces ...	4. *A. Ridleyi.*
Cymes on very short peduncles, 4- to 8-flowered: flowers ·1 in. in diam.; leaves tomentose or pubescent on lower surface	5. *A. nobile.*

1. ALANGIUM LAMARCKII, Thwaites Enum. Pl. Ceyl. 133 A shrub or small tree. *Leaves* variable in form and size, those of the Malayan specimens oblong-elliptic, elliptic to elliptic-ovate or ovate-rotund, the base rounded or slightly cordate, the apex with a short blunt apiculus; upper surface glabrous or nearly so, the lower with a few scattered hairs; main-nerves 4 or 5 pairs, reticulations distinct; length 3 to 6 in.; breadth 2 to 3·5 in.; petiole ·2 to ·3 in. *Flowers* in short dense fascicles of 4 to 8, about ·75 in. long; peduncles, pedicels and outside of calyx rusty-tomentose. *Calyx* cupular, slightly 6-toothed. *Petals* lanceolate,

sub-acute, externally hairy, inside glabrous but with a hairy mesial line. *Stamens* about 18, two opposite each petal and one opposite each sepal, free; filaments slender pilose; *anthers* linear reaching almost to the apices of the petals. *Disc* annular, wavy. *Style* as long as the stamens, 6-grooved; stigma 3-lobed. *Fruit* ellipsoid, slightly compressed, contracted below the disc-bearing mouth, densely and minutely tomentose, ·75 to 1 in. long and ·65 in. in diam. Dalz. & Gibs. Fl. Bombay 109; Brandis For. Fl. N.-W. India 250; Clarke in Hook. fil. Fl. Br. Ind. II, 741; Trimen Fl. Ceylon I, 285. *A. decapetalum*, Lamk. Dict. I, t. 174; DC. Prodr. III, 203; Wall. Cat. 6884; W. & A. Prodr. 325; Wight Ic. t 194 Miq. Fl. Ind. Bat. I, Pt. I, 774; Kurz For. Fl. I, 543. *A. hexapetalum*, Lamk. and DC. ll. c.; Roxb. Hort. Beng. 38; Fl. Ind. II, 502; Wall. Cat. 6883; W. & A. Prodr. 326; Wight Ill. t. 96. *A. sundanum*, Miq. Fl. Ind. Bat. I, Pt. I, 774; Kurz. l.c. *A. tomentosum*, Lamk. and DC. ll. c.; Wall. Cat. 6885. *A. latifolium*, Miq. in Pl. Hohenack. No. 719.—Rheede Hort. Mal. IV, tt. 17, 26.

PERAK: *Scortechini; King's Collector* 5590. SINGAPORE; *Ridley* 6020.—DISTRIB. Brit. India, Malayan Archipelago, S. China, Philippines, East Africa.

VAR. *glandulosa*, Clarke in Hook. fil. Fl. Br. Ind. II, 742. A large climber. *A. glandulosa*, Thw. Enum. Pl. Ceyl. 133; Trimen Fl. Ceyl. II, 286.

ANDAMAN and NICOBAR ISLANDS. DISTRIB. CEYLON.

2. ALANGIUM UNILOCULARE, King. A tree 30 to 60 feet high; young branches minutely rusty-pubescent, slender. *Leaves* membranous, obliquely ovate-lanceolate or oblong-lanceolate, acuminate, the base unequal, one side rounded the other acute, the edges somewhat wavy; upper surface glabrous except the tomentose midrib and pubescent main-nerves; the lower sparsely sub-adpressed pubescent and minutely glandular; main-nerves 4 to 6 pairs, ascending, the lower on one side much branched, all slightly prominent on both surfaces; the main-veins sub-parallel; length 3·5 to 5·5 in.; breadth 1·75 to 2·25 in.; petiole ·25 to ·3 in., villous. *Cymes* axillary, about one-third of the length of the leaves, pedunculate; the branches spreading, rusty pubescent, many-flowered. *Flowers* about ·4 in. long, with subulate bracteoles and short pedicels. *Calyx-tube* funnel-shaped, not grooved, the mouth minutely toothed. *Petals* 5, linear; *anthers* linear; filaments short, broad, woolly at the apex. *Style* cylindric, pubescent; stigma subglobose. *Fruit* ovate in outline, much tapered to the apex, compressed, faintly ridged when dry, ·6 in. long and ·35 in. broad when dry. *Marlea unilocularis*, Griff. Notul. IV, 679. *M. Griffithii*, Clarke in Hook. fil. Fl. Br. Ind. II, 742.

MALACCA: *Griffith* (K.D.) 3387; *Maingay* 708. PERAK: *Wray* 2927, 3486; *Scortechini* 1914; *King's Collector*—many numbers.

3. ALANGUIM EBENACEUM, Griffith MSS. A tree 30 to 70 feet high; young branches rather slender, smooth, dark-coloured when dry. *Leaves* coriaceous, oblong, slightly acuminate, the base cuneate or rounded; upper surface glabrous, the lower with numerous minute pale scales; main-nerves 13 to 16 pairs, spreading, very slightly curved, prominent on the lower surface; length 6 to 10 in.; breadth 2·5 to 4 in.; petiole ·35 to ·8 in. long. *Cymes* from as long to twice as long as the petioles, on short peduncles, axillary, branched, 6- to 12-flowered. *Flowers* sessile, ·65 in. long, and only ·1 in. in diam. *Calyx* cupular slightly grooved; the mouth truncate, slightly toothed. *Petals* 6 (sometimes only 5), linear, minutely pubescent externally. *Stamens* 6 (or 5); *anthers* about as long as the petals, linear; filaments short, compressed, woolly in front. *Style* cylindric-clavate, shortly hairy; stigma pyramidal. *Fruit* ovate in outline, compressed, faintly ridged, about 1 in. long and ·6 in. wide. *Marlea ebenacea*, Clarke in Hook. fil. Fl. Br. Ind. I, 742.

MALACCA: *Griffith* (K.D.) 3384. *Maingay* (K.D.) 706. PERAK: *Wray* 3302; *Scortechini* 1963; *King's Collector* 3252, 5363, 6562, 6626.

4. ALANGIUM RIDLEYI, King. A tree; young branches covered with minute deciduous scales and hairs, rather slender. *Leaves* coriaceous, elliptic, sometimes slightly obovate, shortly and bluntly acuminate, the base cuneate; both surfaces glabrous; main-nerves 10 pairs spreading, slightly curved upwards, bold and prominent on the lower surface; connecting veins parallel, faint; length 6 to 8 in.; breadth 2·5 to 3·5 in.; petioles ·9 to 1·3 in. *Cymes* as long as or rather shorter than the petioles, sessile, 3- to 5-flowered. *Flowers* nearly 1 in. long, ·25 in. in diam. their pedicels ·2 to ·25 in. long, minutely velvety-tomentose like the outside of the calyx and petals. *Calyx* campanulate, slightly furrowed, the mouth wide truncate. *Petals* 6, thick, grooved and minutely hairy inside, oblong-lanceolate, sub-acute. *Stamens* somewhat shorter than the petals; *anthers* narrowly linear, with a tuft of hairs at the base; filaments short flat almost glabrous. *Style* slender clavate; stigma deeply furrowed, disc 6-angled cushion-like, glabrous. *Fruit* unknown.

SINGAPORE, in the Botanic Garden Jungle, *Ridley* 4941.

Ridley's specimens are without fruit. Mr. Wray has sent from Perak some specimens (Herb. *Wray* 3632) of a plant in fruit which in spite of its considerably larger leaves (nearly a foot long), may be conspecific with this. These fruits are narrowly ellipsoid, much compressed and deeply furrowed, narrowly to the base, ess so to the truncate apex. *A. costata*, Boerl. MSS. is the nearest ally of both.

5. ALANGIUM NOBILE, Harms. A tree 60 to 100 feet high: young branches and petioles velvety rusty-tomentose. *Leaves* coriaceous, elliptic to ovate-elliptic, rarely slightly obovate, entire, the base slightly cordate rarely sub-acute, the apex blunt or very shortly and bluntly acuminate; upper surface almost glabrous, the midrib and nerves minutely tomentose: lower surface densely and minutely tomentose or pubescent; main-nerves 8 to 10 pairs, spreading, slightly curved, very bold on the lower surface when dry, the secondary nerves transverse and bold; length 4·5 to 12 in.; breadth 3 to 6·5 in.; petiole ·8 to 1·75 in. *Cymes* on very short peduncles, 4- to 8-flowered, shorter or slightly longer than the petioles. *Flowers* ·5 or ·6 in. long and ·1 in. in diam.; their pedicels very short and thick. *Calyx* narrowly campanulate; deeply 6-grooved; the mouth with 6 deep lanceolate spreading teeth. *Petals* thick, narrowly oblong, sub-acute, tomentose, especially outside, sub-glabrous inside. *Stamens* 6, shorter than the petals, filaments short villous inside; *anthers* linear. *Style* cylindric, adpressed villous; stigmas linear. *Disc* glabrous, deeply 6-lobed. *Fruit* compressed, ridged, ellipsoid in outline, slightly contracted at both ends, tomentose, about 1 in. long and ·65 in. broad. *Marlea nobilis*, Clarke in Hook. fil. Fl. Br. Ind. II, 743.

MALACCA: *Griffith* (K.D.) 3384, 3385. *Maingay* (K.D.); 705, 707. PERAK: *King's Collector* 6047, 6116, 10892. SINGAPORE: *Maingay*; *Ridley* 5077.

Beccari collected in Borneo specimens (Herb. Becc. P.B. 3611) of a species closely allied to this, the flowers of which are however longer (·85 in.) with the calyx-tube much less prominently grooved.

3. NYSSA, Linn.

Trees (or shrubs), innovations silky. *Leaves* alternate, petioled, entire. *Flowers* capitate, on axillary peduncles, polygamo-diœcious, 1 or few females and many males in a head, each 3–4-bracteolate, or the males irregularly coalescing. MALE: calyx short, cup-shaped, 5-7-toothed; petals 5-7, imbricate, hairy; stamens usually 10 (in the Indian species) around a large circular disc; rudiment of the ovary 0 or small. FEMALE: calyx-tube campanulate; limb 5-toothed; petals 0 or minute; rudimentary stamens none; ovary 1-celled; style cylindric, simple or shortly 2-fid; ovule solitary, pendulous. *Berry* oblong or ovoid. *Albumen* copious; cotyledons flat, leafy, nearly as broad as the seeds.—DISTRIB. Species 5-6, in N. America, and from Sikkim to Java.

NYSSA SESSILIFLORA, Hook. fil. in Gen. Plantar. I, 952. A tree. *Leaves* sub-coriaceous, oblanceolate or elliptic-lanceolate tapering to each end, length 4 to 8 in.; breadth 1·5 to 2·5 in.; petiole ·6 to ·8 in.; both surfaces minutely punctate; main-nerves 6 to 8 pairs, spreading.

Peduncles puberulous, ·5 to 1 in. long. *Ripe fruit* oblong-ovoid, smooth, crowned by the small circular calyx, ·6 to ·75 in. long when dry. Clarke in Hook. fil. Fl. Br. Ind. II, 747. *Daphniphyllopsis capitata*, Kurz For. Fl. I, 240; and in Journ. As. Soc. 1875, Pt. II, 201, with fig. *Ilex daphniphylloides*, Kurz in Journ. As. Soc 1870, Pt. II, 72. *Agathisanthes javanica*, Blume Bijd. 645; Miq. Fl. Ind. Bat. I. Pt. I. 839. *Ceratostachya arborea*, Blume Bijd. 644; Miq. l.c.

PERAK: at elevat. of 3,400 feet, *Wray*.—DISTRIB. Sumatra, *Forbes* 2880: *Beccari* (P.S.) 17, 335; Java; Trop. Eastern Himalaya; Khasia Hills.

IV.—Noviciæ Indicæ XIX. *A new Indian* Dendrobium.—*By* D. PRAIN.

[Received February 26th; Read March 6th, 1902.]

Among the Orchids that flowered in the Royal Botanic Garden, Calcutta, during 1901, one of the most beautiful was a *Dendrobium* that differs from any of the Indian species hitherto described. To be assured that the plant is in reality a previously unknown species a drawing from life has been compared with the material and drawings preserved in the great national collection at Kew. The following description of the plant is now therefore offered.

DENDROBIUM REGIUM Prain; *caulibus* erectis parum compressis; *foliis* oblongo-lanceolatis versus apicem oblique retusum vel incisum augustatis; *floribus* 2-3 pedunculo brevi subracemosis, pedunculis e caulis aphylli nodis orientibus; *sepalis* lineari-oblongis obtusis roseo-purpureis lineis rubro-purpureis notatis; *petalis* ellipticis roseo-purpureis lineis rubro-purpureis reticulatis; *mento* brevi lato; *labio* lituiformi aliquantum angustato, limbo roseo-purpureo lineis rubro-purpureis reticulato, glabro; tubo pallide flavo.

HAB. In provinciis Hindustaniæ inferioribus.

Stems 8-12 cm. long, 1·3 cm. thick; nodes 3 cm. apart. *Leaves* 8-40 cm. long, 1·5 cm. wide, tips distinctly obliquely notched. *Peduncles* 2 cm. and pedicels 4 cm. long; bracteoles adpressed, lanceolate, under 1 cm. long. *Flowers* 8 cm. across, magenta with darker lines and transverse markings; *mentum* 1·25 cm. long; *sepals* 1 cm. and *petals* 2·75 cm. wide; *lip* 4 cm. long.

This species is very nearly related to *D. nobile* Lindl. but is quite distinct from any of the known varieties of that somewhat variable species. In the nearly uniform coloration of the sepals and petals (though not in the colour itself) it approaches most closely the form of *D. nobile* distinguished and figured by Lindley, *Sertum* t. 18, as *D. coerulescens*. That plant, however, has a lip with purple throat and yellow margin; the present species has a cream-coloured tube and throat with a magenta limb coloured and marked like the petals and sepals. The lip of *D. regium* is, more over, narrower than in any form of *D. nobile* and is not pubescent.

V.—*On some cases of Abrupt Variation in Indian Birds.*—*By* F. Finn, B.A., F.Z.S., *Deputy Superintendent of the Indian Museum.*

[Received February 26th ; Read March 5th, 1902.]

I. ALBINISTIC VARIATION IN *Dissemurus paradiseus*, *Æthiopsar fuscus*, *Acridotheres tristis*, AND *Pavoncella pugnax*.

The albinistic and other varieties which so frequently occur everywhere among birds are too frequently passed over by ornithologists as mere "freaks" unworthy of careful consideration ; yet every now and then occurs an instance of sudden and abrupt variation, of a type which when found constantly is unhesitatingly allowed the rank of a species.

It is true that the majority of albinistic specimens belong to a form which appears no more capable of maintaining itself in nature than is the perfect pink-eyed albino ; at any rate, just as no pink-eyed species of bird exists in the wild state, so we also find that no species is splashed, pied, or mottled in the irregular manner characteristicof many domestic birds and of the usual pied variety which occurs in wild ones.

Such a specimen is the pied Bhimraj (*Dissemurus paradiseus*) figured on Plate I., in contrast with the type of the species named by me (J.A.S.B. LXVIII, Pt. II. p. 119) *Dissemurus alcocki* ; I have been induced to refigure the latter in order to show that it is no mere albinism. The pied bird had the base of the bill partly whitish, and even some of the rictal bristles white ; it is the only pied specimen of this species I have ever seen, and I have examined many, both alive and dead.

A more interesting and much rarer type of variety, however, is that in which the markings are similar to those occurring in a natural species. Such an one is the specimen of the Jungle Mynah (*Æthiopsar fuscus*) figured on plate II ; and catalogued by Anderson (Cat. Birds, Mus. As. Soc. interleaved Museum copy) as "577, one, albino, Moulmein, Major Tickell."* In this bird the general plumage is white, with the quills, both primary and secondary, and the tail feathers normally coloured. The greater coverts are partly white and partly normal, and thus I am inclined to suspect that this is a similar case to one which I have recently observed in the Common Mynah (*Acridotheres tristis*). In this bird the plumage was originally all white, with the eyes, bill and feet normal. Mr. Rutledge kept it for some time, and it began to change into the normal plumage, remaining for some time white with normal wings and tail, like the present bird. It is now in a very peculiar condition, being only scantily covered with feathers, some white and some normal. It has for a companion a normally-coloured bird, which, as I can personally testify, was once white, though not so completely so.

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* This colouration of white body and dark quills and tail is normal in the Javan *Graculipica melanoptera*, a bird which I was able to study in life in the London Zoological Gardens in 1901. Since writing this paper I have seen another grizzled specimen of *Dissemurus paradiseus.*

Another case of albinism of unusual interest is furnished by the white-headed form of the Ruff (*Pavoncella pugnax*), which is apparently not uncommon, at all events in Eastern specimens of this bird. Though the male is so well known to be exceedingly variable when in summer plumage, it is as constant in colour during the winter as other birds. Yet every now and then there appears a specimen in winter plumage with the head and neck more or less white, varying from complete whiteness of these parts to merely a white nape and unusually white fore-neck. All of the birds thus characterized are adults, as is shown by their orange or flesh-coloured feet (these being olive in the young); and the females or Reeves are thus affected as well as the Ruffs, but far more rarely and to a less extent.

In the stuffed pair figured in Plate III., which are part of the Asiatic Society's collection, and were procured by Blyth during the years 1842–1846, the whole head and neck are white with the exception of the crown, which is mostly normal, and of some scattered brown feathers on the neck. They are numbered 1601B (the female) and 1601K (the male).

In a skin (2340 in the Museum Register) procured on in the Calcutta Bazaar, February 19th, 1875 evidently a male from the dimensions, the whole head, neck and upper breast are white, there are a few white feathers on the upper back, and the coverts along the fore-arm and carpus are partly white. This is figured in the plate, together with another male (Reg. No. 24005) obtained this winter (January 30th, 1902), which is even whiter, having more white feathers on the back and fore-arm, and one tertiary white. In this the feet and base of bill were flesh-coloured; the eyes normal.

Six more specimens of the variation have been obtained by me in the Calcutta Bazaar during the present winter, all being adult males. One (Reg. No. 24006) is whiter than either of those figured, having the upper back largely white, as well as all the head and breast, but no abnormal amount on the wings.

The second whitest specimen, (Reg. No. 24007) procured on February 2nd, has a white head and neck, with normally coloured feathers round the face; it had the feet and base of bill orange.

Of the others, one, procured on February 16th (Reg. No. 24018) closely resembles Blyth's male figured; another, procured on February

3rd (Reg. No. 24024) is also similar, but has the back of the neck normal; one, procured on February 22nd (Reg. No. 24019) has the head normal and the neck white all round; and a rather small specimen, obtained on February 11th (Reg. No. 24008) has the neck all white in front and the head and back of the neck merely mottled with white.

This nearly approaches the normal form, in which the fore-neck shows a varying amount of white; but any white on the crown or nape may fairly be called an abrupt variation.

I have not this year been able to procure any specimens of this variety in good enough condition to keep alive, but early last year I was more fortunate, and got two pairs, most of which are still living in the Alipore Zoological Garden. Both males much resemble the mounted male figured, but one has some tertiaries white in both wings at the present time, though when obtained it only showed white in one wing. The one female which remains alive merely has the neck white all round.

During last winter I remember seeing one male largely white-necked, which was dead, and I therefore did not buy it, not then attaching so much importance to the variety, as I had seen so few.

It is only during the last two winters that I have taken special notice of this species, but I could not very well have overlooked the conspicuous white-headed form had it occurred commonly before; and it is to be noted that these last two winters have been noteworthy for unusually numerous occurrences of the Bronze-capped Teal (*Eunetta falcata*) in the Bazaar, a bird usually decidedly rare in India. It is possible, therefore, that these white-headed Ruffs are an Eastern strain, which, like the duck above-mentioned, only occasionally migrate in a westerly direction. It will be noticed also that during the years 1842-46 that Blyth procured his specimens, he also got the Clucking Teal (*Nettium formosum*) and Eastern White-eyed Pochard (*Nyroca baeri*), also eastern irregular visitants to our empire.

As out of so many specimens of this variety seen by me only three were females, we may conclude that the variation is largely limited to the male, Reeves here at all events being much more numerous than Ruffs. I have above shown that it only occurs in old birds, and thus I am inclined to look on it as a species of senile albinism analogous to what occurs in black varieties of the domestic fowl and duck. I have also seen an ageing green Canary turn largely yellow about the head.

At the same time, these white-marked individuals are not at all wanting in vigour; the two white-headed males at the Calcutta Zoological Gardens have survived while all the normally coloured Ruffs procured that winter (1900-01) have died, though kept under similar conditions; and one now, although crippled to a great extent in one wing, is master of most if not all the normally coloured Ruffs again placed with him in another aviary. Yet a Reeve, which was at first his sole companion of the species, seems to have deserted him for a normally coloured bird.

The only-slightly-mottled specimen alluded to above also, though undersized and slightly lame, often attacked and beat a larger, though younger, normally-coloured male confined with it, which was sound.

In conclusion, it seems to me, that whether the unusual number of this variety which have appeared of late is due to an abnormal westerly migration or not, it seems to be a well-marked and definable form, liable to recur again and again, and very probably hereditary; thus it would be likely to increase, unless checked by natural or sexual selection.

The Ruff could probably afford to run a greater risk than most birds, as it is evidently a vigorous species, more hardy of constitution, courageous, and indiscriminate in its diet than most *Limicolæ*; this is shown by its readiness to eat vegetable as well as animal food, its habit of constantly fighting, in which both sexes indulge as well in winter as in summer, and its power of recovering from injuries and enduring so unnatural a climate as that of Bengal.

As it is desirable to distinguish a well-marked and recurrent aberration like this by a subspecific name, I venture to suggest that it be known as *Pavoncella pugnax leucoprora*.*

II. NOTE ON THE *Gallus pseudhermaphroditus* OF BLYTH.

With the attention that is now being paid to the variation of animals under domestication, it may not be *mal à propos* to recall to the memory of naturalists the curious variety of the fowl described many years ago, though doubtfully, by Blyth, under the name of *Gallus pseudhermaphroditus.* The specimen is alluded to in his catalogue of the birds in the collection of the Asiatic Society under No. 1463 as "P. Singular individual (?) variety, from Mergui, described as *G. pseudhermaphroditus*, J.A.S.X, 925. Rev. J. Barbe (1841)."

The specimen still exists, and, unlike too many of Blyth's birds, has suffered little deterioration, and hence I have thought it advisable to give a figure of it here (Plate II), as I have never seen or heard of a similar variation myself. I also reproduce below the original description from page 925 of the tenth volume of our Society's Journal, since this is not very readily accessible now-a-days:—

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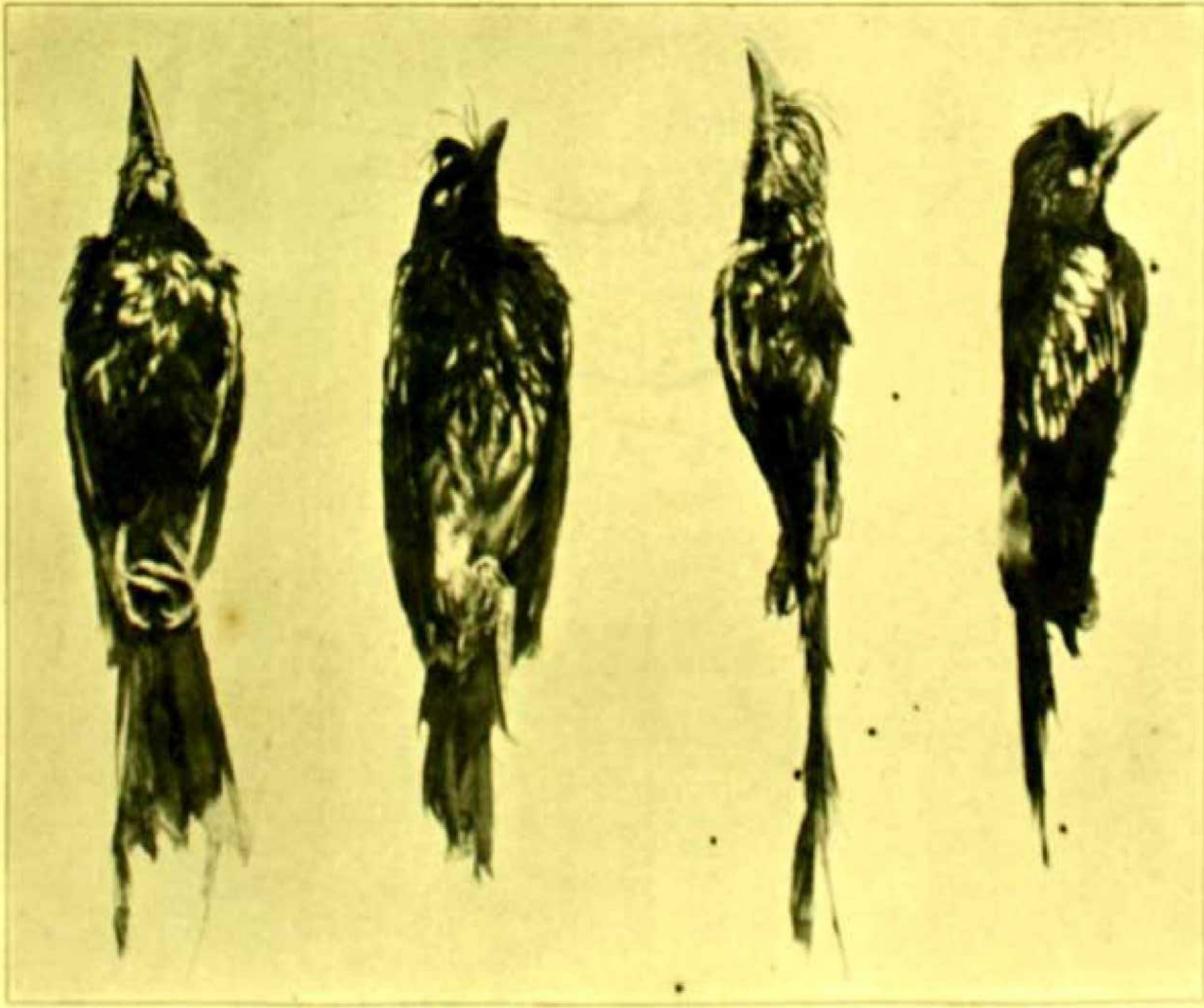
* *Diagnosis*—Exemplis hibernis *P. pugnacis* similis, sed capite et nuchâ aut omnino albis aut albo variegatis distinguenda.

"*Gallus pseudhermaphroditus*, Nobis, N.S. ?——— A very singular bird, which, if I was not positively assured, was a male in normal plumage, I should have suspected to be either an individual of mingled sex, or possibly an aged male; for that it is not a female in partially masculine attire is evident from the size of its comb and wattles, and especially of its spurs. Size of an English game cock, or larger than the male *G. Bankivus*, having much stouter legs, the spurs of which are $1\frac{1}{2}$ inches long; comb and wattles as in the *G. Bankivus*, but the former more entire towards the front (possibly a mere individual diversity): the tail is that of a cock bird of this genus, but scarcely more developed than in the *Euplocomi* (as *Eu. albocristatus*); in other respects the plumage is altogether that of an ordinary brown hen, having a redder cast than in the female *G. Bankivus*, especially on the wings; tail coloured as in an ordinary male. Length about 2 feet, of which the middle tail feathers occupy 10 inches, wing from bend 9 inches, and tarse behind, to back toe, $2\frac{3}{4}$ inches. I am informed that this species is never clad in the usual bright plumage of other male birds of its genus."

The specimen now only shows one long central tail-feather or "sickle," the other having apparently been broken, since there is a large broken feather on the opposite side of the tail. From the look of the comb and the coarse legs with abnormally enlarged anterior scales, there can be little doubt that the bird was really a domestic one; and if its peculiarities were as a matter of fact racial, it would seem that there has existed in the east, a breed of which the cocks bore more or less feminine plumage, comparable to the "Henny" game still existing in England; which, however, are *altogether* hen-feathered.

I have never seen any hen-feathered cocks among the very variable domestic poultry which occupy the coops in the Calcutta Bazaar; and I should like here to draw attention to the fact that the operation of caponizing, so frequently performed in India, results in more finely-developed male plumage in the cockerels operated on, although their combs and wattles do not develop fully, but remain like those of hens.

PLATE I



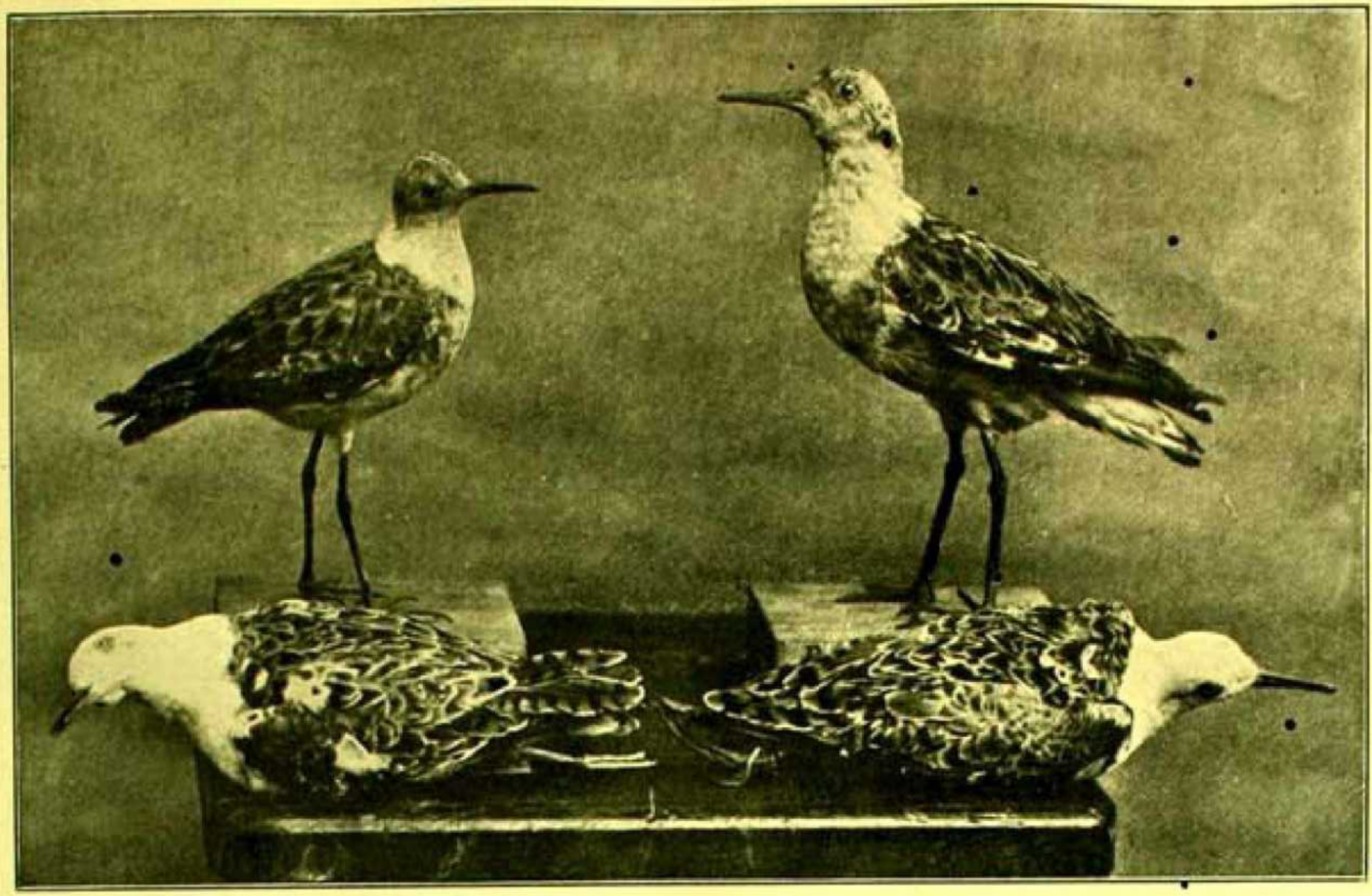
DISSEMURUS
PARADISEUS, VAR.

DISSEMURUS
ALCOCKI

DISSEMURUS
PARADISEUS, VAR.

DISSEMURUS
ALCOCKI.

PLATE III.

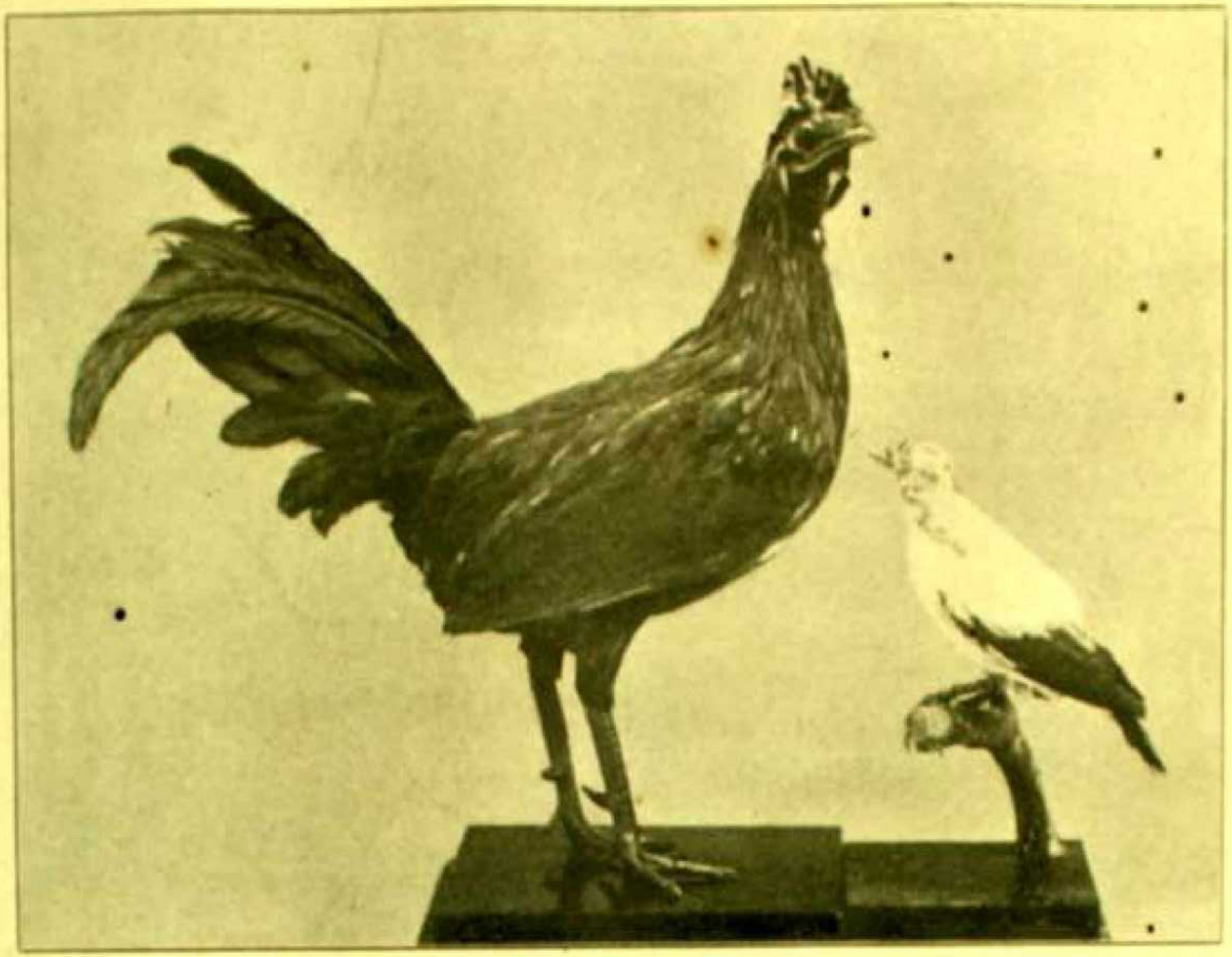


PAVONCELLA PUGNAX LEUCOPRORA.

Female (1842—46).
Male (Jan. 30th, 1902).

Male (1842—46).
Male (Feb. 19th, 1875).

PLATE II.



GALLUS PSEUDHERMAPHRODITUS

ÆTHIOPSAR FUSCUS, *Var.*

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No. II.—1902.

VI.—*On specimens of two Mauritian Birds in the collection of the Asiatic Society.—By* F. FINN, B.A. F.Z.S., *Deputy Superintendent of the Indian Museum.*

[Received March 26th ; Read April 2nd, 1902.]

I. ON A SPECIMEN OF THE MOORHEN FROM MAURITIUS.

In Blyth's catalogue of the Birds in the Museum of the Asiatic Society, p. 286, one of the specimens of *Gallinula chloropus* is noted as follows:—G. Var. ? From the Mauritius. Presented by Willis Earle, Esq.

This specimen is still in existence, but as it is in poor condition, having lost many feathers, and the remainder being loose in places, I have deemed it well to have it figured, as it presents certain points of interest which make its appearance worthy of record. (*See* Plate IV).

Being a stuffed specimen it is not easy to measure exactly with regard to length, but with a tape I make it out to be 1 ft. ¾ inches from tip of bill to end of tail, a fair average length judging from the measurements given by Dr. Sharpe in the British Museum Catalogue of Birds. The wing, however, is only about 6·1 inches, and although its feathers are much abraded, it could never have been more than about 6½ inches long, whereas Dr. Sharpe gives 7·3 inches as the length of wing for a bird measuring only a foot and half an inch in length, *i.e.*, about the size of this one. The tail of the Mauritius birds is 2·5 inches in length, whereas the British Museum specimen alluded to has the tail 2·9.

The most remarkable point about the present bird however is its powerful bill and feet. The beak, with frontal shield, measures 1·65 inches; in thickness, at the proximal end of the nostril, it is ·45 of an inch, whereas the biggest-billed Old World bird in the Indian Museum

Collection, a Kashmir specimen, has a bill and frontal shield of 1·6 inches, with the depth of bill measured in the same place, of ·4 only. The wing of this bird measures 6·3.

The left shank of the Mauritius bird, measured from the upper end of the tarso-metatarse to the setting-on of the front-toes, is 2·2 inches, as against the 1·8 of the Kashmir bird; but the thickness of the shank across the front, midway down its length, is ·2 in the former as against ·15 in the latter. I have not measured the shanks from front to back, so as to avoid any error from the insertion of wires into the legs of the Asiatic Society's specimen. The middle toe and claw of the Mauritius bird only exceed those of the Kashmir specimen by about ·1 of an inch, so that in the insular specimen the toes have decreased in relative length. Another remarkable point about the Mauritius bird is that it has the frontal shield, which is very large, truncate behind even more markedly than in the American *Gallinula galeata*; that is to say, judging from our two specimens of the latter, which show so much variation in this character as to suggest that those authors who only allow the New World birds the rank of a subspecies are correct. The differences in the frontal shields will be easily be apparent from the full-sized figures given in Plate V. It will be seen that the Mauritius bird has as long a bill as the Lake St. Clair example of *G. galeata*, whose wing measures 7·4 inches.

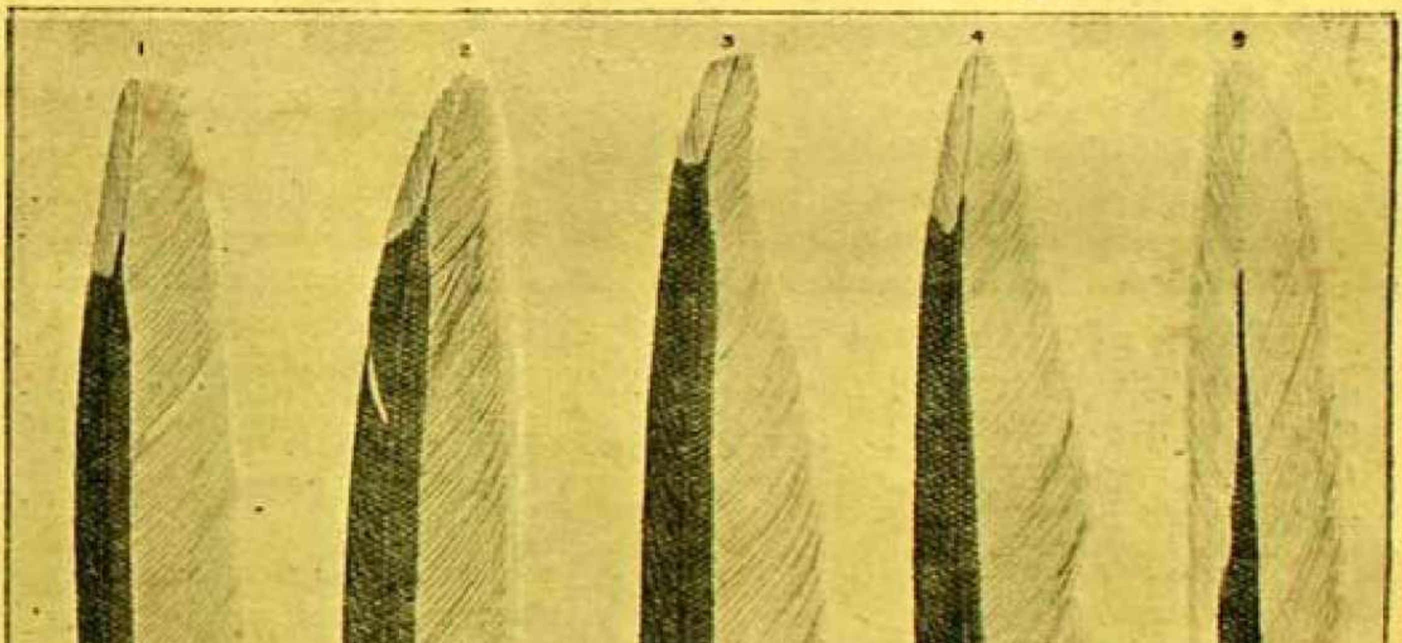
To sum up, the present specimen of *G. chloropus* from Mauritius, when compared with normal specimens, exhibits an increase of the size of the bill and feet, and a shortening of the wings, tail, and toes, which show that it has progressed some way in the direction of the flightless forms of *Gallinula* separated in the British Museum Catalogue as *Porphyriornis*. In colouration it does not differ from *G. chloropus*; it is true that the under-tail coverts are cream-colour instead of white, but this is probably due to the age of the specimen. Professor A. Newton's *G. pyrrhorhoa*, described from Mauritius, has these ochreous under-tail-coverts; but the tinge has been shown by Dr. R. B. Sharpe (Cat. Birds, B.M., Vol. XIII, p. 173), to exist in English specimens, and one in the Indian Museum collected by Colonel C. T. Bingham in the Shan States also exhibits it. Another character given by Professor Newton is the yellowness of the legs of *G. pyrrhorhoa*; but from an old specimen like the present one it is quite impossible now to say of what colour the legs originally were.

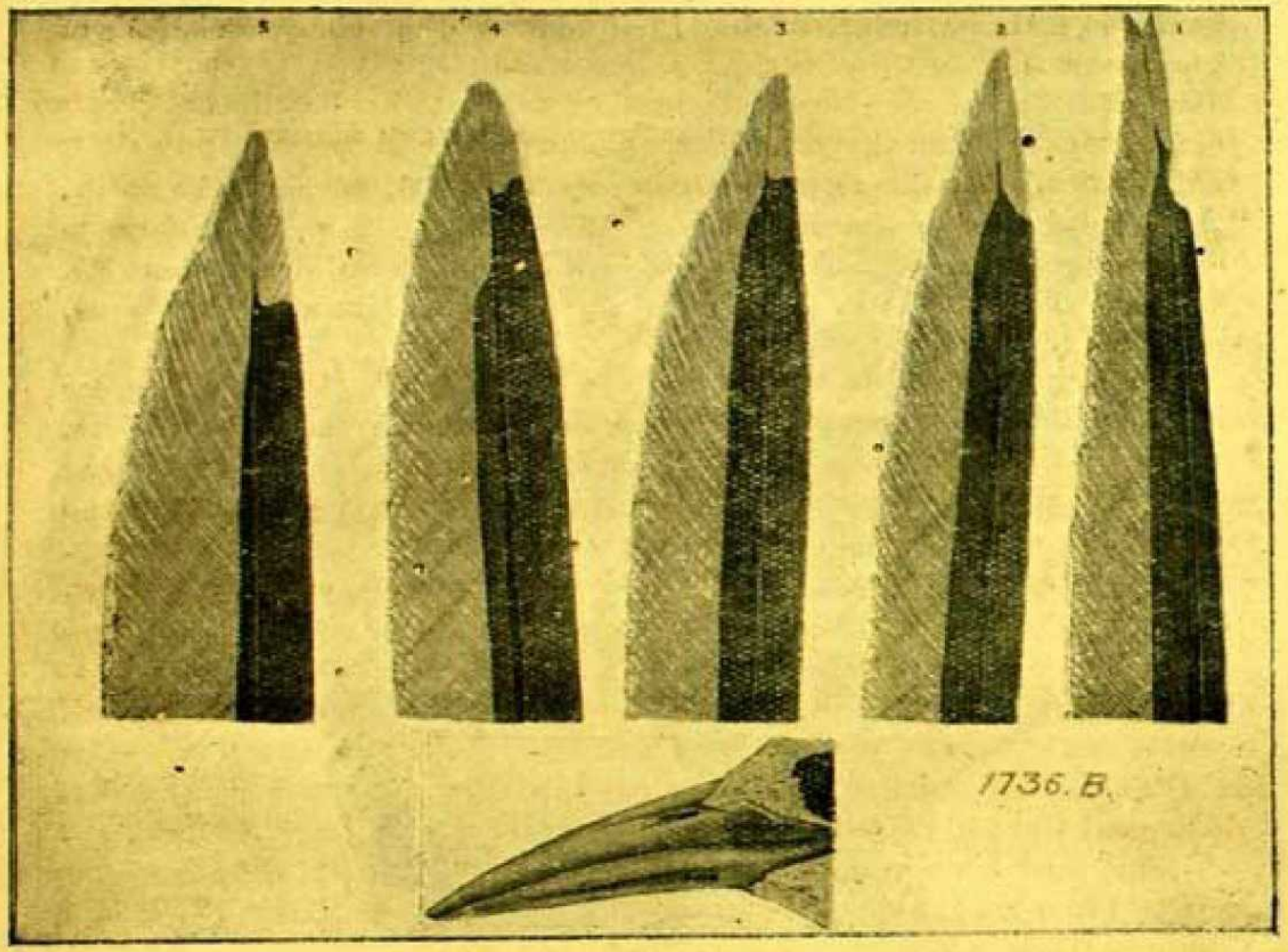
It seems to me, therefore, that the Moorhens of Mauritius need re-examination; if they normally present the stoutness of build and brevity of wing and tail characteristic of the present specimen, they certainly constitute a recognizable race, which might well bear the name bestowed by Professor Newton, since that ornithologist expressly mentions a large frontal shield as one of the characteristics of *G. pyrrhorhoa.*

II. ON TWO SPECIMENS OF A TROPIC-BIRD FROM MAURITIUS.

In Blyth's Catalogue, under the number 1736, we find the entry, "A.B., Adults, from the Mauritius. Willis Earle, Esq.," in reference to two specimens of a Tropic-bird which he there designates *Ph. candidus.* This is the *P. lepturus* of the British Museum Catalogue, Vol. XXVI, p. 454.

I find, however, that while specimen A of Blyth's Catalogue agrees with the British Museum Catalogue description in most particulars, specimen B is distinct, and resembles *Phaëthon americanus* in having shorter white tips to the first four primaries, and in having the outer web of the fifth entirely black to within a short distance of the extremity. Both birds also have evidently had the bill almost entirely yellow, unlike that of *P. lepturus* as described. (*See figures below*).





Except for this bill and for the slightly shorter white tips to the quills, **1736A** is true *P. lepturus*, which, from the British Museum Catalogue list of specimens, occurs at Mauritius, and it may therefore, I think, be referred to that species, although not entirely agreeing therewith.

The other specimen, B, however, is not so nearly in agreement with *P. americanus*, for while it has a nearly completely yellow bill, the white tips of the first four primaries are never so little as half an inch long, and the third quill is not nearly all black, but marked like the rest, although the fifth has a good deal of black along the outer web as in *P. americanus.*

Thus these two specimens do not agree with the description of any species of *Phaëthon;* and yet they differ far too much from each other to be referred to a separate form. I am therefore disposed to think that they are both *Phaëthon lepturus;* and this must be a variable species, since it can produce, in the Old World, one individual showing a considerable approximation to the American *P. americanus*, in the colouration of the bill and quills; and another which approaches the American form in the colouration of the bill only. It is, of course, just conceivable that a specimen of *P. americanus* strayed at one time to Mauritius and interbred with the local birds; but the distribution of the form renders this unlikely, and I should be rather inclined to put down the peculiarities of these birds to simple variation.

VII.—*On hybrids between the Guinea-fowl and Common fowl.*—*By* F. FINN, B.A., F.Z.S., *Deputy Superintendent of the Indian Museum.*

[Received March 26th; Read April 2nd, 1902.]

A good account of this cross, which is not by any means common, has been given by Dr. Juan Vilaro, in the Bulletin of the American Museum of Natural History, Vol. IX. (1897), p. 225.

The hybrid, as represented in the plates accompanying Dr. Vilaro's papers has a very characteristic appearance, its general form and carriage being intermediate between the Fowl and Guinea-fowl, and its head devoid of the comb and gular wattles of the one and rictal wattles and casque of the other. I was thus easily enabled to recognize as Guinea-fowl hybrids three curious fowls received by the Calcutta Zoological Garden from Mr. A. T. Blewitt, of Kalka, early in 1899.

They had been caught in a wild state, but this is not surprising as the tame-bred hybrid between the domestic Muscovy Duck and Common Duck is known to become feral at times.

These birds all resembled Common fowls in colour, the largest being splashed with white and red-brown, and the other two (one of which is figured on Plate VI) being red-brown with black necks and fine black pencilling on many of the feathers. The characteristic spotting of the Guinea-fowl was altogether absent. All had bare flesh-coloured faces, and a pendulous dewlap, most marked in the large white-spotted specimen. There was no comb, although a bare median area at the base of the bill above seemed to indicate a rudiment; and the rictal wattles of the Guinea-fowl were just indicated at the gape; of the horn of the Guinea-fowl and gular wattles of the fowl there was no trace at all. The specimen figured was a male, the testes being about the size of haricot beans; of the others, which have also died and been transferred to the Museum, the brown specimen has been preserved entire in spirits, and the other made into a skeleton. The taxidermist who prepared it states that it was a female, which I should certainly not have suspected from seeing the three birds alive. All were larger than a Guinea-fowl or ordinary Indian fowl, and had particularly strong bills and legs, the latter of a black colour. Their behaviour was quiet; but they were never placed with other birds, so I do not know how they would have treated these. Like Dr. Vilaro's specimens, they seemed to be very sensible to heat, panting more than other birds, and their only cry was a piping, chirping sound, very different from the harsh note of the birds which came under Dr. Vilaro's observation.

VIII.—*Notes on Animals kept in the Alipore Zoological Garden. No. I.—By* RAI K. B. SANYAL BAHADUR, *Superintendent of the Garden.*

[Received March 26th; Read April 2nd, 1902.]

OBSERVATIONS ON THE HABITS OF ORANG OUTANG IN CAPTIVITY.

Orang Outang thinks and acts with a view to accomplishing an object. An Orang Outang and a Proboscis Monkey (*Semnopithecus* [*Nasalis*] *larvatus*), lived in two contiguous cages separated by iron gratings. Although of different temperaments—the Orang Outang lively, vivacious and prone to mischief, and the monkey phlegmatic and indolent—they were best of friends; and enjoyed each other's company as much as the intervening partition would allow. The Orang's friendship for the monkey was, however, not altogether disinterested. They were usually fed about the same time upon the same kind of food, and as the Orang Outang was blessed with a keen appetite, he had no scruple to help himself, to as much of his friend's share as chance brought within his reach. One morning he was found making desperate attempts to annex the remnants of the monkey's breakfast by repeatedly thrusting his arms through the gratings. But all his tricks and trouble availed him not, as the light tin vessel containing the tempting morsel lay beyond the reach of his long arms. Having failed in his attempt to get at the food, he sat still for a few seconds as if to collect his thoughts, and to devise means for the accomplishment of his object, and presently made a rush into his sleeping apartment, fetched a quantity of straw, and twisted it into a sort of rough rope, and with it began striking the tin vessel containing the food, and ultimately succeeded in bringing it within the reach of his arms.

Orang Outang imitating human action. It is well known that in their wild state Orang Outangs indulge in the habit of building platforms of twigs and branches on large trees. Given opportunities they would do the same in captivity also.

The Orang Outang whose habits are here chronicled, was a remarkably docile animal, and was, therefore, allowed to enjoy as much freedom as it was deemed safe. The first use that he made of his liberty was to build himself a platform on one of the trees that stood close to his habitation. One cloudy August morning, while seated on his arboreal perch, he noticed some early visitors open out their umbrellas to protect themselves from a passing shower of rain, and straightway he broke off a leafy branch and held it umbrella-fashion over his own head in immitation of the human folks!

It was amusing to see him following visitors who happened to have anything tied in their cloth, or who carried a bundle on their head. Quick to observe, he had noticed some of them untying a bundle to give him a feed, and by a simple process of ratiocination he came to connect all bundles with food and feeding!

PHYSIOLOGICAL ECONOMY OF ANIMALS AFFECTED BY ACCIDENTS.

A Large White Egret (*Herodias alba*) having lived happily in the Garden for many years managed to break one of its legs by sustaining a fracture of its left tarsus. The fracture was set up and the wound healed nicely, but the shock of the accident must have materially affected the physiological economy of the bird's system; as during the next two years it did not assume the full breeding plumage, or the bright green of the facial skin which it usually did in summer and which was such a characteristic feature of the bird Although in about three years after the accident it began putting on the summer dress again, there was a marked deterioration in the character of the plumes and the colour of the facial skin. This might have been due to old age also.

IX.—*On the Variation of the Flower of* Ranunculus arvensis.—*By* I. H. BURKILL, M.A.

There is a regular sequence of organs in the Phanerogamic flower,—sepals, petals, stamens, carpels,—which is never departed from, and which may be said to be due to the passing of moods over the axis,—a mood for the formation of sepals, a mood for the formation of petals, a mood for the formation of stamens, and a mood for the formation of carpels. Each mood is preclusive in its time of the others and definite; and the flower axis runs through them as a matter of course.

In the flower, mood follows mood very closely; yet the tendency so widely manifest, for the floral organs to be formed in whorls is a separating of the moods each from its neighbours by concentrating on itself.

The symmetry of the flower depends firstly on this regular sequence and separation of the moods; it depends secondly on the way in which successive rings of organs,—sepals, petals, etc.—are commonly isomerous.

I have been driven to a conviction that the separation of these moods has not yet obtained the attention it deserves. We need to know much about them; chiefly as to the conditions which lead to their separation: for the whole Phanerogamic subkingdom shows us that the more specialised a flower is the more distinctly are its moods separated; and the isolation of the moods is undeniably of far-reaching importance in the growth of perfect floral symmetry.

It may be said that there are questions of four kinds to be asked regarding the moods, (i) why the moods exist, (ii) as to the reason of their sequence, (iii) as to the requirements which have made them as distinct as they are, and (iv) as to the causes leading to a determination of the number of lateral organs which belong to each of them severally.

They are questions in organography, as Goebel terms the causative morphology of the new school, in order to distinguish it from the descriptive morphology which is subservient to the systematist. The foundation of organography is in the Darwinian theory of evolution.

The present paper concerns questions of the fourth kind; but in preface I wish to make some brief remarks regarding the second and the third kind of question. Regarding the second: the sepals are formed outermost to protect; the petals are formed second to attract; and we have these reasons for the position of both; but why the mood for the formation of stamens should invariably precede that for the formation of carpels is a question which must remain a subject for speculation almost as long as the origin of the Phanerogams is unsolved. This only can be said, that somehow the formation of female organs puts a period to the forward growth of the axis, whereas the forming stamens have divided with the axis the available nutrition passing beyond the growing sepals and petals. This perhaps means some advantage in the matter of food to one or the other. I do not say which: but it is to be confessed that there are strong reasons for assuming that, in nature generally, conditions of good nourishment tend more to the formation of female than of male organs: for experiments on the lower plants—Algæ, Fungi and Vascular Cryptogams—have shown that there is a tendency for female reproductive organs to be formed when the plants are well nourished, male organs when they are starved: and extensive observations on animals indicate the same thing. A condition so widely true may well be true also of the Phanerogams; but at the present time can we produce any convincing evidence that the developing bud gets better nourished as it progresses from the formation of sterile protective or showy organs, through male organs to female organs, or that the female organs appropriate two shares of nutriment because there is by them that which might belong to an elongating axis ?

Regarding the third kind of question, let it be remarked that intermediate organs are apt to be useless organs and that therefore we see one reason for the distinctness of the moods; secondly, it is to be stated that if we let ourselves believe that sepals, petals, stamens and carpels are formed under conditions of nutrition which change as the axis gives rise to them, we still cannot easily assume that the conditions of nourishment change as abruptly as do the moods.

Lastly, with regard to the fourth kind of question we are bound to suppose that a certain relationship between the number of the stamens and carpels exists which is at least not prejudicial to the maintenance of the race; *i.e.*, that enough stamens must be produced to enable a sufficiency of seed to be set by the carpels; and it is reasonable to believe that the petals and the sepals are required by their biological functions to bear a more or less definite proportion to the organs they protect or make conspicuous: but it will be acknowledged that this supposition implies a force too loose in its action to produce isomerism as we see it, too loose to regulate the not uncommon orderly change of a normally tetramerous flower to pentamerism, or of a normally pentamerous flower to hexamerism, and impossible to accept as the sole factor when we glance at the general absence of intermediate conditions between isostemony and diplostemony. The view to which Schwendener's and Karl Schumann's work leads, can carry us a step beyond this supposition; for, as they have shown, we have strong reasons for believing that the symmetry of a flower is largely influenced by the mutual pressure in the bud of part on part, and that this pressure to a considerable degree compels new organs to appear in the niches between those recently formed. Thus do the sepals—the outermost members of the flower—as it were set the step and, *e.g.*, if they are in rings of five (I use the word ring because I require a term less definite than whorl) the petals and stamens frequently follow in fives.

The carpels too may follow the step, but their position is unique in that the axis is no longer growing forward when they form and new conditions of pressure, as perhaps of nutrition, are possibly existing.

The individual and the race are always in slight antagonism: the race asks for reproduction, and some writers such as Axell have thought that they could see in the flower the most perfect adaptation or subservience to reproduction. But our flower, above conceived, asserts the individual distinctly if we allow the possible formation of sexual organs by order according to nutrition available, and the fixing of the number by the need of packing. I shall show later, at least in *Ranunculus arvensis*, another assertion of the individual—a setting aside of the claims of the race by allowing a kind of right of primogeniture to the moods in the flower. This right of primogeniture is the more interesting when we consider it in connection with the view that sepals and petals are sterilised stamens; for it gives preference to the mood which by origin is then supposed secondary.

The above remarks are to be taken as embodying some notion of the foundations of the Phanerogamic flower. Working upon them we may make a study of a particular species of plant in order to seek how far the fixed and definite relationships of the organs in number to one another, which we can observe in most Phanerogams, may be due to the compelling influence of pressure in the bud acting inwards from the outermost organs (sepals), or to the way in which nutrition becomes available in the developing axis, or to nutrition and the influence of pressure combined, or to the attempt of the plant to produce an effective and economical assemblage of reproductive members. I have proposed to approach the question by comparing the variation in adjacent sets of floral organs, and seeing how far in different types of flower any one set is free to deviate from pattern.

There are flowers where the jointing of set on set may be considered to be loose, where adjacent rings of organs are not isomerous and such flowers seemed best for my purpose. One such is *Parnassia palustris* where a 4-merous ovary tops an otherwise 5-merous flower; another is the garden Gloxinia where 2 carpels top a similarly 5-merous (potentially in stamens) flower. It is to be asked if, as a rule, variation from normal is more easily accomplished on the upper side of the badly fitting joint than elsewhere. If so, then the inference is obvious that pressure is playing a large part in keeping to type the moods of that flower which are well jointed.

This I found to be the case with *Parnassia palustris*. In 1894 and 1895 I examined over 5,000 flowers and I recorded my observations in the Journal of Botany, 1896, pp. 12–15.

I had approximately 5,152 flowers normal in the number of sepals and in only two of them did the petals, stamens and staminodes fail to keep true to symmetry; but the carpels diverged from the normal four in 450 cases. I had 36 flowers abnormal in the number of sepals, 15 with only four, 21 with six, and in all but three of those flowers petals, stamens and staminodes followed the lead and varied with the sepals; but in them eleven flowers had three carpels, nine had the usual four, fourteen had five and two had six. So much for the free variation above the badly fitting line in Parnassia. In the garden Gloxinia on which I have made, when at Kew, some unpublished observations, it is the same. Gardeners have selected and raised beautiful races with more than the normal number of petals; the selection was never for the sepals or stamens, but these two sets of organs have varied hand in hand with the petals while the ovary which normally has two carpels hesitates in the improved race between two and three.

A table which I gave in my note on Parnassia shewed that when the sepals were 4, the carpels were generally 3; and when the sepals were 6, the carpels were generally 5. Herein we see a correlative increase or decrease in both. Now it is easier by $\frac{1}{20}$ of the unit to squeeze five than to expand three into the space of four and it happened in Parnassia, as I showed in a table on page 13 of the Journal, that five carpels were more common in 6-merous than three in the 4-merous flowers,—an observation in accord with ideas of pressure but of a ring on a confined area; and not of organs compelling others to fall into the niches between them. Towards satisfying myself in this matter, I devised a little machine for measuring divergences and succeeded in demonstrating (see *Annals of Botany*, XV, 1901, pp. 187-192) that, at least when near fruit-ripening, the carpels in Parnassia have no very exact relationship in position to the sepals.

After examining Parnassia I sought for a flower with worse fitting joints or better with no joints at all and took *Ranunculus arvensis* for my purpose.

Ranunculus arvensis is a little cornfield weed of Europe and Temperate Asia, an annual and easily grown. It is very variable in the flower and in all parts of it; it has not got that concentration of the moods for the formation of the various floral organs which occurs in all regularly whorled flowers, its moods for the formation of petals and stamens being particularly ill-defined. These irregularities seemed to me qualifications suiting it particularly to my purpose. The sepals are commonly 5 with a divergence of $\frac{2}{5}$, the petals are 5 or fewer alternating with the sepals and repeating their divergence; but the stamens and carpels have a completely different arrangement; the former are very variable in number and the latter generally 4–7.

I grew my plants in 1895 in the University Botanic Garden, Cambridge, from seed which had ripened in the Botanic Gardens of Bonn and Hiedelberg, Paris, Stockholm and Bordeaux, and in 1898 in a window box at Kew from seed which had ripened in the years 1896 and 1897 in the Royal Botanic Gardens, Kew. I made a point of examining every flower produced, counting and recording the number of its sepals, petals, stamens and carpels, and noting any obvious abnormalities in it. For the purpose the flowers were picked when just open, and this picking, done daily, caused the plants to continue long in blossom.

In this way I examined in 1895, 1,383 flowers from Heidelberg seed and 1,203 from Bonn seed; in 1898, 2,298 from Kew 1896 seed (157 plants) and 1,589 from Kew 1897 seed (73 plants); and also in 1895 lesser numbers of flowers from Paris, Stockholm, and Bordeaux seed—numbers too small to be of real service. I give the results of the examination of the Paris, Stockholm and Bordeaux plants here before proceeding. I shall not mention them again.

	No. of flowers.	Average No. of Sepals.	Average No. of Petals.	Average No. of Stamens.	Average No. of Carpels.
Stockholm	135	4·94	4·49	8·27	5·87
Paris	382	4·91	3·50	5·50	5·25
Bordeaux	167	4·95	4·10	6·74	5·37

As to the more profitable experiments I found the different sowings to vary as follows :

Table I.—Variation in Sepals.

No. of Sepals.	0	1	2	3	4	5	6	7	8	9
Heidelberg	...	...	...	1	85	1,287	8	1	0	1
Bonn	...	1	0	9	69	1,121	2	0	1	...
Kew, Old	...	...	2	13	63	2,217	3	...	...	...
Kew, New	1	3	4	18	46	1,516	1	...	...	...

Table II.—Variation in Petals.

No. of Petals.	0	1	2	3	4	5	6	7	8
Heidelberg	...	5	126	486	417	345	3	1	...
Bonn	...	4	82	349	438	327	1	1	1
Kew, Old	2	2	26	237	430	1592	9	...	...
Kew, New	3	2	19	182	289	1091	3	...	...

Table III.—Variation in Stamens.

No. of Stamens.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Heidelberg ...	...	1	12	21	65	136	238	308	282	170	98	32	8	4	3	3	1	1	...
Bonn	.	1	4	9	21	81	154	247	294	211	123	36	8	5	6	0	2	1	...
Kew, Old	...	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	...	...
Kew, New ...	...	3	6	30	143	292	265	203	190	140	95	74	60	46	25	1	4	1	1

Table IV.—Variation in Carpels.

No. of Carpels.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Heidelberg ...	3	3	13	95	266	511	314	136	31	8	0	0	1	0	0	1	1
Bonn ...	5	10	4	35	155	426	379	153	28	6	2	...	...	...	...	...	...
Kew, Old ...	...	3	24	175	362	634	584	403	107	6	...	...	...	...	...	...	...
Kew, New ...	1	2	16	68	198	353	391	364	158	37	1	...	...	...	...	...	...

There is an obvious difference between the two German races and the Kew race and some difference between the Kew plants from 1896 seed and those from 1897 seed although they belonged to the same stock. The variation curves which may be plotted from these figures are irregular, and those for no one set of organs exactly correspond with those for neighbouring sets: the curves of the sepals are half-Galton curves: and the curves of the petals in the Kew race are also half-Galton curves, but not quite as those for the sepals; while the curves of the petals in the German races are intermediate between half-Galton and symmetric Quetelet binomial curves: the curves for the stamens are equally asymmetric, but in a different way; while the curves for the carpels are the most nearly bi-symmetric of all but are not quite so. It is evident from a comparison of them that the flower does not vary as an unit as for instance a Tulip flower may, every ring of organs changing from 3-merism to 4-merism; but each mood varies in its own manner. We shall learn more of this independence of the moods in variation by studying their association. I cannot give tables of the combinations observed in the different races for all the four sets of organs taken two together, without occupying a great amount of space; I therefore give tables for the "Kew Old" plants alone. They will serve as an illustration for all, as the tables which could be given for the German races and "Kew New" are not unlike them.

Table V.—Kew, Old—Correlation of Sepals and Petals.

Sepals.	0	1	2	3	4	5	6	Total No. of flowers.	Average No. of Sepals.
0 Petals	...	...	...	...	...	2	...	2	...
1	...	...	...	...	...	2	...	2	...
2	...	...	1	...	2	23	...	26	4·81
3	...	...	...	7	24	205	1	237	4·85
4	...	...	1	6	26	396	1	430	4·89
5	...	...	...	...	10	1,582	...	1,592	4·99
6	...	...	...	...	1	7	1	9	5·00
Total No. of flowers ...	...	...	2	13	63	2,217	3	2,298	...
Average No. of petals...	...	...	...	3·46	3·71	4·60	...	...	...

Table VI.—Kew, Old—Correlation of Sepals and Stamens.

Stamens.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total.	Average.
Sepals ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...
2 ...	...	..	...	...	...	2	...	..	...	...	...	...	...	...	...		...	2	...
3 ...	...	...	...	4	4	2	2	1	...	...	...	...	...	.	...	...	..	13	4·39
4 ...	...	...	...	10	17	18	5	4	3	3	1	0	2	...	...	...	...	63	5·25
5 ...	...	1	5	48	208	410	419	299	267	131	139	97	71	69	27	17	9	2,217	7·01
6 ...	...	...	...	...	...	1	2	...	...	...	...	...	..	...	...	...	...	3	...
Total	..	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	2,298	...
Average	...	...	...	4·71	4·89	4·94	4·98	4·98	4·99	4·98	4·99	5·00	4·97	5	5	5	...	...	...

Table VII.—Kew, Old—Correlation of Sepals and Carpels.

Carpels.	0	1	2	3	4	5	6	7	8	9	10	Total.	Average.
Sepals ...	...	...	...	...	...	...	...	...	...	...	...	...	...
2 ...	...	...	...	...	2	...	...	...	...	...	...	2	...
3 ...	...	...	2	3	4	3	0	1	...	...	...	13	3·92
4 ...	...	1	2	21	20	10	6	3	...	...	...	63	4·05
5 ...	...	2	20	150	335	621	577	399	107	6	...	2,217	5·46
6 ...	...	...	...	1	1	0	1	...	...	...	...	3	...
Total ...	...	3	24	175	362	634	584	403	107	6	...	2,298	...
Average ...	...	...	4·75	4·84	4·93	4·97	4·99	4·99	5·00	...	...	...	...

Table VIII.—Kew, Old—Correlation of Petals and Stamens.

Stamens.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total.	Average.
Petals ...		..	...	...	...	...	...	...	...	...	...	...	...	...	..		...	...
0 ...	1	0	0	1	...	...	...	...	...	...	...	...	...	...	..		2	...
1 ...	...	..	1	0	0	0	1	...	...	...	...	...	...	...	..		2	...
2 ...	...	..	6	10	7	1	1	1	...	...	...	...	...	...	...		26	4·38
3 ...	...	3	24	88	48	35	32	4	3	...	...	...		...	..		237	4·91
4 ...		1	17	70	137	95	56	19	15	12	6	0	1	1	...	...	430	5·77
5 ...	...	1	14	59	237	295	212	246	116	128	91	73	68	26	17	9	1,592	7·91
6 ...	...		...	1	4	2	2	...	...	...	...	...	...	...	...		9	...
Total	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	2,298	...
Average	..	...	3·60	3·77	4·42	4·61	4·59	4·89	4·84	4·86	4·94	5·00	4·98	4·98	5	...	...	...

Table IX.—Kew, Old—Correlation of Petals and Carpels.

Petals.	1	2	3	4	5	6	7	8	9	Total.	Average.
Carpels	...	...	...	...	...	...	...	...	...	...	...
0	...	...	...	...	1	0	1	...	...	2	...
1	...	...	2	...	...	...	...	...	...	2	...
2	...	1	9	14	2	...	...	...	...	26	3·65
3	2	13	70	88	52	12	...	...	...	237	3·89
4	1	10	64	126	141	66	18	4	...	430	4·69
5	...	...	30	134	415	502	382	103	6	1,592	5·88
6	...	...	...	...	3	4	2	...	...	9	...
Total ..	3	24	175	362	634	584	403	107	6	2,298	...
Average	...	3·38	3·65	4·06	4·60	4·85	4·95	4·96	...	...	...

Table X.—Kew, Old—Correlation of Stamens and Carpels.

Stamens.		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total.	Average.
0 Carpels	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...
1	...	...	...	...	2	...	1	...	...	...	...	...	...	...	...	...	...	...	3	...
2	...	...	...	...	4	10	6	3	1	...	...	...	...	...	...	...	...	...	24	4·46
3	...	...	...	3	26	54	60	19	11	2	...	...	...	...	...	...	...	...	175	4·61
4	...	...	...	2	18	87	99	83	50	19	3	1	...	...	...	...	...	...	362	5·35
5	...	...	1	...	7	55	175	67	104	80	24	15	5	1	...	...	...	...	634	6·18
6	...	...	...	...	3	17	73	17	95	106	56	47	26	23	17	4	...	...	584	7·66
7	...	...	...	...	1	6	17	116	39	55	48	58	52	35	36	12	5	3	403	9·44
8	...	...	...	...	1	...	2	33	4	8	3	19	13	14	16	10	11	3	107	11·05
9	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	1	3	6	...
Total	...	...	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	2,298	...
Average	...	...	...	...	3·68	4·14	4·68	5·16	5·36	5·80	6·18	6·56	6·78	6·93	7·02	7·30	7·76	...	...	...

If we take three absolutely symmetrical dice and toss them the probable scores obtained in 240 throws mathematically calculated are as follows:—

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	3	6	10	15	21	28	36	36	28	21	15	10	6	3	1

If we take another three dice of distinguishing colour absolutely symmetrical, and throwing them with the others record the association of numbers, the resulting table will be as symmetric as the binomial curve just given, but in two dimensions, and out of 14,400 throws there is one chance of 3 + 3 being the score of the two sets of dice and one of 18 + 18, one of 3 + 18 and one of 18 + 3; there are three chances of the score being 4 + 3, and three of its being 17 + 3, *i.e.*, equal chances as far as the extremes are concerned of there being a close similarity between the figures and a wide dissimilarity. A glance at the tables just given will satisfy that this is not the case in them and that the tendency to similarity is evident; that in the mutual relationship of mood to mood the adjustment is not a question of chance but, as is indicated by the averages in the last column and lowest line of each table, is due to some loosely coercing force which will be discussed.

As I have foregone the publishing of tables to give for the Kew New plants and the Bonn and Heidelberg races my exact observations on adjustment of moods, I place below the averages found omitting those derived from fewer flowers than ten.

I will briefly call attention to the chief points in the averages. Table XI shows that fewer sepals mean fewer of all other organs and it is to be noted that the reduction is greatest in the organs furthest away from the sepals. Table XII shows for the Kew race a considerable reduction of both stamens and carpels when the petals are reduced; it shows for the German races a much slighter reduction of carpels and an insignificant reduction of stamens. It shows further that reduction in the number of petals does not act as a reflex on the number of sepals in anything like the way in which reduction of sepals may be said to promote reduction of petals. Table XIII shows that with a reduction or increase of stamens the reduction or increase of the carpels is much greater than the reduction or increase of the organs which preceeded them. Table XIV shows that reduction or increase of carpels is accompanied by a more nearly corresponding reduction or increase in the organs closest to them. Consequently, admitting that there is an exception in the relation of petals to stamens in the German races, we may broadly state that the influence producing correlative increase or decrease chiefly acts forwards from the preceding mood to the moods which follow and that correlative increase and decrease is closest in neighbouring moods.

Table XI.—Average No. of other organs in association with three, four and five Sepals.

Number of Sepals.		3	4	5
Average No. of Petals ...	Kew, Old	3·46	3·71	4·60
	Kew, New	3·56	3·57	4·58
	Bonn	2·78	3·54	3·87
	Heidelberg	...	3·47	3·72
Average No. of Stamens...	Kew, Old	4·39	5·25	7·01
	Kew, New	4·73	5·37	7·42
	Bonn	3·78	7·31	7·83
	Heidelberg	...	6·28	7·27
Average No. of Carpels ...	Kew, Old	3·92	4·05	5·46
	Kew, New	3·67	4·09	5·94
	Bonn	2·11	4·79	5·48
	Heidelberg	...	4·31	5·19

Table XII.—Average No. of other organs in association with two, three, four, five and six Petals.

Number of Petals.		2	3	4	5	6
Average No. of Sepals ...	Kew, Old .	4·81	4·85	4·89	4·99	5·00
	Kew, New ..	4·58	4·76	4·87	4·98	...
	Bonn ...	4·83	4·91	4·92	4·98	...
	Heidelberg ...	4·93	4·95	4·89	4·99	...
Average No. of Stamens	Kew, Old ...	4·38	4·91	5·77	7·81	8·55
	Kew, New ...	4·47	4·97	6·00	8·12	...
	Bonn ...	7·84	7·68	7·68	7·98	...
	Heidelberg ...	7·17	7·20	7·18	7·35	...
Average No. of Carpels ...	Kew, Old ...	3·65	3·89	4·69		5·45
	Kew, New ..	3·37	4·21	5·12	6·36	...
	Bonn ...	4·94	5·18	5·45	5·82	...
	Heidelberg ...	4·74	4·82	5·25	5·63	...

Table XIII.—Average number of other organs in association with 2–16 Stamens.

Stamens.		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Average No. of Sepals...	Kew, Old ...	...	4·71	4·89	4·94	4·98	4·98	4·99	4·98	4·99	5·00	4·97	5·00	5·00	5·00	5·00
	Kew, New ...	...	4·77	4·67	4·92	4·95	4·97	4·98	4·98	4·99	5·00	5·00	5·02	5·00	5·00	...
	Bonn ...	...	4·33	4·86	4·87	4·91	4·93	4·97	4·93	4·95	5·03	5·00	...	...	...	...
	Heidelberg ...	4·83	4·86	4·81	4·88	4·94	4·95	4·98	4·92	4·97	4·97	5·00	...	...	...	...
Average No. of Petals ...	Kew, Old ...	...	3·60	3·77	4·42	4·61	4·59	4·89	4·84	4·86	4·94	5·00	4·98	4·98	5·00	5·00
	Kew, New ...	...	3·40	3·81	4·18	4·49	4·68	4·83	4·87	4·97	5·00	4·98	4·96	5·00	4·73	...
	Bonn ...	...	3·44	3·71	3·81	4·00	3·81	3·55	3·79	3·75	4·03	3·62	...	...	...	...
	Heidelberg ...	3·67	3·76	3·38	3·80	3·87	3·59	3·63	3·68	3·70	4·06	4·12	...	...	...	...
Average No. of Carpels	Kew, Old ...	...	3·68	4·14	4·68	5·16	5·36	5·80	6·18	6·56	6·78	6·93	7·02	7·30	7·76	7·00
	Kew, New ...	...	3·80	4·65	4·91	5·39	5·79	6·28	6·79	6·85	7·31	7·39	7·40	7·96	7·36	...
	Bonn ...	...	2·89	4·14	4·58	4·81	5·13	5·54	5·91	6·10	6·53	6·75	...	...	...	...
	Heidelberg ...	4·92	4·19	4·20	4·41	4·79	5·02	5·43	5·71	6·11	6·34	7·50	...	...	...	...

Table XIV.—Average number of other organs in association with 1–9 Carpels.

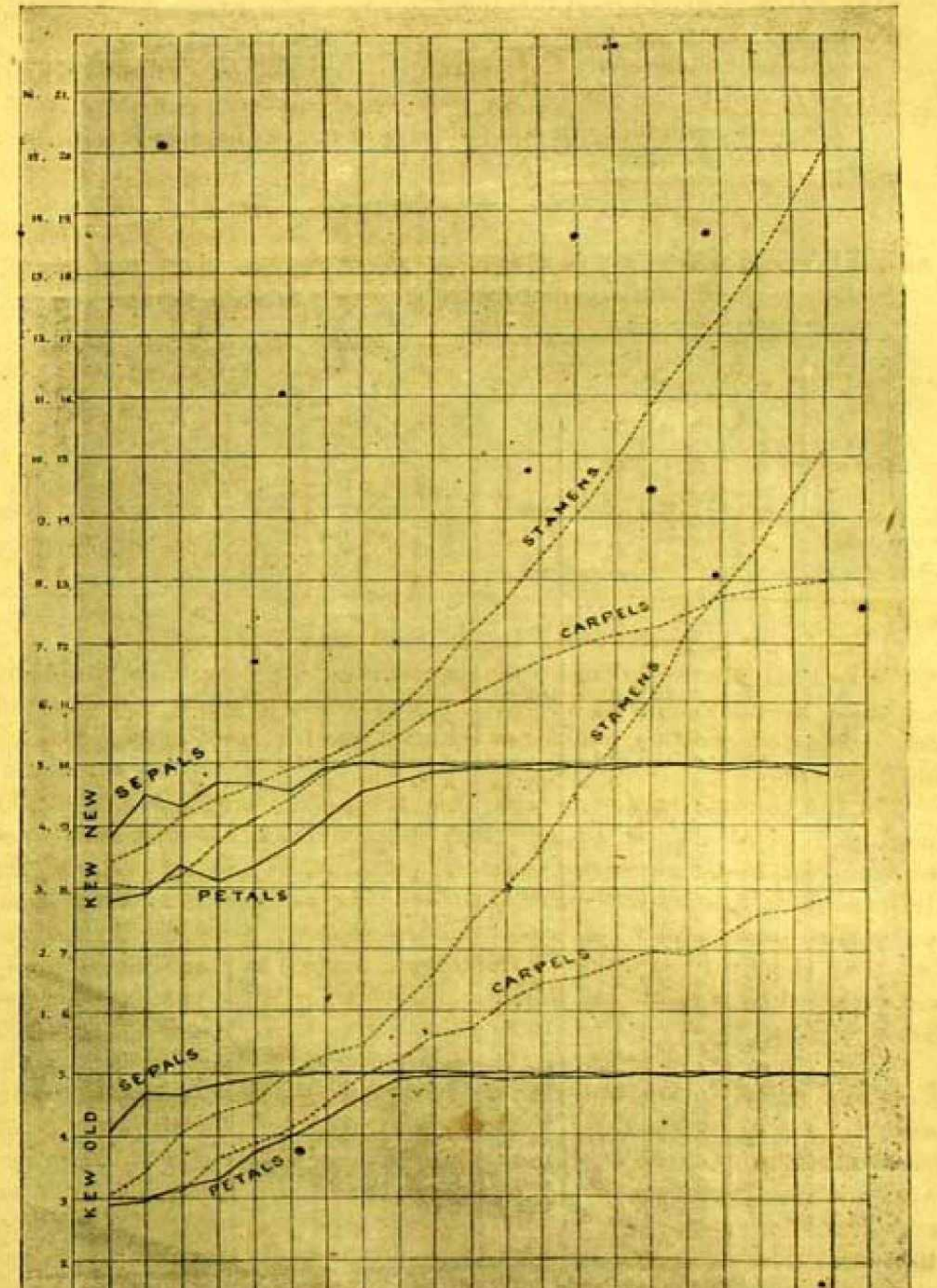
Carpels.		1	2	3	4	5	6	7	8	9
Average No. of Sepals ...	Kew, Old ...	...	4·75	4·84	4·93	4·97	4·99	4·99	5·00	...
	Kew, New ...	...	4·69	4·41	4·78	4·96	4·98	5·00	4·98	5·00
	Bonn ...	4·20	...	4·74	4·87	4·94	4·97	4·97	5·00	...
	Heidelberg ...	...	4·62	4·79	4·90	4·96	4·97	5·04	5·06	5·00
Average No. of Petals ...	Kew, Old ...	...	3·38	3·65	4·06	4·60	4·85	4·95	4·96	...
	Kew, New ...	...	3·31	3·18	3·77	4·51	4·73	4·88	4·91	4·95
	Bonn ...	3·66	...	3·60	3·52	3·74	3·94	4·11	4·36	...
	Heidelberg ...	...	3·44	3·18	3·43	3·58	4·03	4·19	4·09	4·12
Average No. of Stamens ...	Kew, Old ...	...	4·46	4·61	5·35	6·18	7·66	9·44	11·05	...
	Kew, New ...	...	3·94	4·63	5·22	5·98	7·16	8·87	10·27	10·68
	Bonn ...	4·90	...	6·03	6·72	7·28	8·25	9·18	9·57	...
	Heidelberg ...	...	5·50	5·84	6·37	7·11	7·84	8·50	8·90	8·50

I must now point out some differences between the races.

When one sepal less than the complete five is present in the Kew race there is approximately one petal less, two stamens less and ½ carpel less: when two sepals are wanting then we lose further ⅛ petal, ⅔ stamen and ¼ carpel.

In the German races one sepal less than the complete five means roughly ⅓ petal less, ¾ stamen and ⅔ carpel: when two sepals are wanting we lose a further ¾ petal, 3½ stamens, 2½ carpels; *i.e.*, in the German races 4 sepaled flowers are more nearly otherwise normal than in the Kew race: and what is true for the sepals is true for the petals, *i.e.*, that the first reduction in them from normal is much more closely accompanied by a reduction in other organs than is the case in the two German races.

Apportionment of organs in the Kew race.—The least flower of the Kew race had 8 organs in all, the largest 36. The largest flowers were richest in stamens, the least richest in sepals. I give in table XV the average number of sepals, petals, stamens and carpels in flowers with varying numbers of total organs, and over leaf are curves expressing the result graphically. The result may be briefly stated thus:—if there is power to produce more than 15 organs the sepals claim their full compliment; if there is power to produce more than 20 organs, the petals also claim their full compliment; if there is power to produce more than 28 organs the carpels begin to show signs of



Graphic representation of the apportionment of sepals, petals, stamens and carpels in flowers of *Ranunculus arvensis* (Kew race) with the number of organs varying from 13 to 33.

satiety; extra power beyond this goes chiefly to the stamens. At 20 the flower is not far from having the formula K5 C5 A5 G5, *i.e.*, from being regularly 5-merous. The staminal curve shows slight irregularities at 15 and 18 the curves for petals and carpels practically touch at 15. The correspondence in the two sets of curves is most interesting.

Table XV.—Apportionment in flowers of the Kew race with the number of total organs varying from to 8 *to* 36.

No. of organs.	KEW, OLD.					KEW, NEW.				
	No. of flowers.	Average No. of Sepals.	Average No. of Petals.	Average No. of Stamens	Average No. of Carpels.	No. of flowers.	Average No. of Sepals.	Average No. of Petals.	Average No. of Stamens.	Average No. of Carpels.
8	...	...		...	...	1	0	3·00	1·00	4·00
9	...	...	...	...	...	0	...	...	...	...
10	...	...	...	...	...	1	2·00	3·00	4·00	1·00
11	4	4·25	1·75	2·50	2·50	0	...	...	...	...
12	2	4·00	3·00	3·50	1·50	5	3·40	3·00	3·40	2·20
13	14	4·07	2·86	3·07	3·00	17	3·77	2·77	3·41	3·06
14	32	4·72	2·91	3·41	2·97	20	4·50	2·85	3·70	2·95
15	66	4·70	3·15	4·03	3·12	28	4·29	3·36	4·14	3·21
16	80	4·81	3·26	4·34	3·59	55	4·71	3·18	4·42	3·69
17	115	4·92	3·72	4·54	3·82	61	4·70	3·33	4·67	4·13
18	127	4·95	3·99	4·99	4·06	93	4·59	3·67	4·97	4·47
19	173	4·98	4·26	5·27	4·49	81	4·98	4·12	5·07	4·83
20	238	4·99	4·60	5·47	4·93	154	5·00	4·52	5·34	5·14
21	256	4·98	4·82	6·00	5·21	146	4·98	4·72	5·83	5·47
22	236	4·99	4·86	6·55	5·60	157	5·00	4·81	6·37	5·81
23	188	4·99	4·96	7·32	5·72	127	4·98	4·87	7·13	6·02
24	172	5·00	4·91	7·91	6·14	119	4·99	4·92	7·68	6·40
25	128	4·99	4·93	8·63	6·45	109	5·00	4·90	8·38	6·72
26	105	5·00	4·93	9·54	6·52	104	4·99	4·99	9·07	6·95
27	84	4·99	4·98	10·29	6·75	76	5·00	4·96	9·84	7·20
28	93	5·00	5·00	11·05	6·97	68	5·00	4·99	10·78	7·24
29	64	5·00	4·99	12·09	6·92	48	5·00	5·00	11·54	7·45
30	54	5·00	5·00	12·78	7·22	49	5·00	4·96	12·29	7·75
31	29	5·00	4·97	13·45	7·58	42	5·02	4·98	13·21	7·79
32	14	5·00	5·00	14·36	7·64	16	5·00	4·94	14·12	7·94
33	15	5·00	5·00	15·13	7·87	7	5·00	4·86	15·14	8·00
34	4	5·00	5·00	15·75	8·25	3	4·67	4·67	16·33	8·33
35	3	5·00	5·00	16·00	9·00	1	5·00	5·00	16·00	9·00
36	...	...	...	...	...	1	5·00	5·00	16·00	10·00

Table XVI.—Apportionment in flowers of the German races with the number of total organs varying from 4 to 47.

No. of organs.		Bonn.					Heidelberg.				
		No. of flowers.	Sepals.	Petals.	Stamens.	Carpels.	No. of flowers.	Sepals.	Petals.	Stamens.	Carpels.
4	...	1	1·00	1·00	1·00	1·00	...	...	...	...	...
5-7	...	0	...	...	...	...	...	...	...	...	...
8	...	2	3·00	2·50	2·50	0	...	...	...	...	...
9	...	1	3·00	3·00	2·00	1·00	...	...	...	...	...
10	...	2	3·50	2·00	4·00	0·5	...	...	...	...	...
11	...	2	5·00	3·00	2·50	0·5	1	3·00	4·00	1·00	3·00
12	...	0	...	..	...	...	3	4·00	2·66	3·66	1·66
13	...	3	3·66	2·67	3·33	3·33	4	4·50	2·75	2·75	3·00
14	...	4	4·00	3·00	4·25	2·75	12	4·58	2·50	3·50	3·42
15	...	7	4·14	3·14	5·00	2·71	23	4·87	3·09	3·96	3·09
16	...	15	4·60	3·13	5·07	3·20	45	4·73	3·00	4·51	3·75
17	...	37	4·90	3·22	5·00	3·89	73	4·79	3·34	5·18	3·68
18	...	44	4·73	3·44	5·75	4·09	97	4·87	3·30	5·72	4·11
19	...	88	4·98	3·29	6·21	4·52	162	4·97	3·33	6·27	4·43
20	...	153	4·92	3·55	6·73	4·78	174	4·97	3·44	6·75	4·84
21	...	157	4·94	3·74	7·23	5·09	221	4·99	3·69	7·13	5·19
22	...	173	4·97	3·80	7·80	5·42	155	4·96	3·77	7·85	5·43
23	...	162	4·98	3·96	8·34	5·73	132	4·96	4·05	8·20	5·79
24	...	150	4·96	4·12	8·80	6·12	112	4·99	4·33	8·60	6·08
25	...	88	5·00	4·35	9·09	6·56	69	5·02	4·39	9·18	6·42
26	...	47	5·00	4·40	9·81	6·77	46	5·04	4·22	9·91	6·83
27	...	34	5·00	4·71	10·28	7·00	27	5·00	4·55	10·15	7·30
28	...	13	5·08	4·69	10·77	7·46	10	5·10	4·70	10·50	7·70
29	...	9	4·89	4·67	12·11	7·33	5	5·40	5·40	11·60	6·60
30	...	1	5·00	5·00	11·00	9·00	4	4·75	5·00	11·50	8·75
31	...	4	5·00	5·00	13·50	7·50	2	5·00	5·00	14·50	6·80
32	...	2	5·00	5·00	14·00	8·00	1	5·00	5·00	15·00	7·00
33	...	1	5·00	5·00	14·00	9·00	1	5·00	5·00	16·00	7·00
34	...	1	5·00	5·00	17·00	7·00	1	5·00	4·00	10·00	15·00
35	...	1	5·00	5·00	16·00	9·00	0	...	...	...	...
36	...	0	...	...	...	...	1	9·00	5·00	15·00	7·00
37-40	...	0	...	...	...	...	0	...	...	...	...
41	...	1	8·00	7·00	16·00	10·00	0	...	...	...	...
42-46	...	..	...	...	...	...	0	...	...	...	...
47	...	...	...	...	...	...	1	7·00	7·00	17·00	16·00

Apportionment in the German races.—I give in table XVI the figures for the German races. As in the Kew race so here, in poor flowers the sepals are most numerous and in rich flowers the stamens are most numerous. But in these German races the petals do not claim their full number until the flower is rich enough to have 29 or 30 organs and on the part of the carpels no tendency to be satisfied can be detected.

Mathematical expression of the curves in formulæ seems to be by no means impossible although they are complicated.

There is no fiat which says "this will be a flower of *Ranunculus arvensis*, the organs may vary in number a little from the ideal." But the fiat says "this will be a flower and must run throughout all its moods. So long as all are present let them jostle for their compliment." So they jostle and the older win as far as they may by being already established at the time when the younger begin to compete; the sepals take what they want only being forbidden from getting the whole five when that would leave too little for the other moods; and the petals following claim their portion in the same way but a little less strongly. There is left a residue for the stamens and carpels, and the larger it is, the more organs do the moods of both sets, but especially the stamens, obtain.

Nutrition.—If seeding be prevented, *Ranunculus arvensis* dies flowering in utter depletion. Therefore I could get from this little proletarian flowers formed under the best conditions and under the worst possible conditions of nutrition, and so seek the effect of starvation on the moods spoken of. My earlier paper (*Journ. Linn. Soc., Botany*, Vol. XXXI, p. 235) contained a note on this plant to show that in it, as in several other plants, the first formed flowers are richest in stamens and carpels; I can now give fuller statistics, and shall show distinctly that the flower is pauperised with the ageing of the plant. I have divided the flowering period of the plants grown in 1895 into three periods and of those grown in 1898 into four periods. The decrease with age in the number of parts in the flower is shown by the following averages:—

Table XVII.—Kew, Old. Average number of organs in flowers at different periods.

	Period 1. 6th July to 17th July.	Period 2. 18th July to 29th July.	Period 3. 30th July to 10th August.	Period 4. 11th August to 23rd August.
Sepals	4·99	4·98	4·99	4·89
Petals	4·95	4·85	4·66	3·95
Stamens	11·58	7·81	6·17	4·93
Carpels	6·78	5·97	5·28	4·15

Table XVIII.—Kew, New. Average number of organs in flowers at different periods; periods as in Table XVII.

	Period 1. 6th July to 17th July.	Period 2. 18th July to 29th July.	Period 3. 30th July to 10th August.	Period 4. 11th August to 23rd August.
Sepals	4·99	4·99	5·00	4·77
Petals	4·97	4·84	4·67	3·81
Stamens	11·63	7·95	6·14	5·07
Carpels	7·22	6·51	5·74	4·36

Table XIX.—Bonn. Average number of organs in flowers at different periods.

	Period 1. June 6th to July 10th.	Period 2. July 11th to August 29th.	Period 3. August 30th to middle of September.
Sepals	4·96	4·92	4·98
Petals	4·22	3·43	3·69
Stamens	8·80	7·74	6·85
Carpels	5·71	5·58	4·75

Table XX.—Heidelberg. Average number of organs in flowers at different periods; periods as in Table XIX.

	Period 1. June 6th to July 10th.	Period 2. July 11th to August 29th	Period 3. August 30th to middle of September.
Sepals	5·00	4·94	4·98
Petals	3·92	3·70	3·49
Stamens	8·24	6·99	7·07
Carpels	5·21	5·16	5·01

With this reduction in number of parts there is a reduction in the size of the flower and there is also a loss of fertility in the anthers. This loss of fertility is shown in the following tables.

Table XXI.—Staminodes in Kew plants at different periods; the periods the same as in Tables XVII and XVIII.

		Period 1. 6th July to 17th July.	Period 2. 18th July to 29th July.	Period 3. 30th July to 10th August.	Period 4. 11th August to 23rd August.
Kew, Old	Total number	91	1360	1572	1777
	Percentage of stamens reduced ...	2·58	21·31	47·49	56·48
	Average per flower ...	0·30	1·66	2·91	2·78
Kew, New	Total number	23	1072	1534	1178
	Percentage of stamens reduced ...	0·78	25·88	64·73	54·09
	Average per flower ...	0·09	2·06	3·98	2·74

Table XXII.—Staminodes in the German races at different periods; periods as in Tables XIX and XX.

		Period 1. June 6th to July 10th.	Period 2. July 11th to August 29th.	Period 3. August 30th to mid-September.
Bonn ...	Total number ...	24	82	33
	Percentage of stamens reduced ...	2·04	1·13	4·01
	Average per flower ...	0·18	0·09	0·27
Heidelberg ...	Total number ..	37	75	36
	Percentage of stamens reduced ...	1·86	1·13	2·61
	Average per flower ...	0·15	0·08	0·19

I think it will be conceded that poverty of organs and sterility of stamens are alike marks of the plants becoming worn out.

Different organs are unequally reduced in numbers, the stamens most of all and before the others. Tables XVII to XX show how the different organs are differently affected by the reduction: but to make this quite evident the following tables are given:—

Table XXIII.—Rate of reduction of organs in the Kew plants from period to period; periods as before.

		Periods 1 to 2	Periods 2 to 3.	Periods 3 to 4.
Kew, Old ...	Sepals	Practically *nil.*		0·10
	Petals	0·10	0·19	0 71
	Stamens	3·17	1·64	1·24
	Carpels	0·81	0·69	1·13
Kew, New ...	Sepals	Practically *nil.*		0·23
	Petals	0·13	0·17	0·86
	Stamens	3·68	1·81	1·07
	Carpels	0·71	0·77	1·38

Table XXIV.—Rate of reduction of organs in the German races from period to period; periods as before.

		Periods 1 to 2.	Periods 2 to 3.
Bonn ...	Sepals	Practically *nil.*	*Very small increase*
	Petals	0·79	*slight increase*
	Stamens	1·06	0·89
	Carpels	0·13	0·83
Heidelberg ...	Sepals	0·06	*increase of* 0·04
	Petals	0·22	0·21
	Stamens ...	1·20	*increase of* 0·08
	Carpels	0 05	0·15

It is easily seen that at the beginning of the flowering period a large reduction is made in the male organs; but that the reduction in other organs is chiefly at the end. The following table shows this excess of masculinity, which occurs at the beginning of the flowering period and is soon done away with after flowering has commenced.

Table XXV.—The percentage which the Stamens (fertile and infertile) make out the total of organs in the flowers, at different periods; periods as before.

	First period.	2nd period.	3rd period.	last period.
Kew, Old	68·52	56·68	53·89	54·29
Kew, New	61·16	54·98	51·68	53·77
Bonn	60·68	58·11		53·76
Heidelberg	61·13	60·93		58·55

It is impossible to dissociate the lack of nutrition felt, it must be believed, by the flowers of the worn out plants and the right of primogeniture spoken of. The power to satisfy the sepaline mood and the petaline mood and to form abundant stamens and carpels is in the nutrition of the flower.

On page 110, it was said that the moods jostle for their compliment of organs and that the older win by being already established when the younger begin to compete. There is a reservation to make in regard to this statement, to demonstrate which table XV has been recast in table XXVI. The latter table shows that in well and fairly well fed flowers—say with 20 organs and more—the proportion falling to the carpellary mood is nearly constant, and that, as already made more or less evident, the staminal mood is residuary legatee for the extra vigour. Therefore for the richer flowers the vigour may be said to be roughly apportioned between on the one hand the sepaline, petaline and staminal moods which three jostle each other, and on the other hand the carpellary mood. In flowers poorer in organs than 20, the carpellary mood seems less prepared for, and is subject in like degree to the staminal mood to the jostling for space.

Thus do the richer flowers appear more pre-apportioned than the poorer ones and therefore more knit together into an unit in the direction in which the flowers of most Phanerogams are knit together. We may easily believe that, given a flower with its moods so knit together that they vary together, the force of pressure of organ on organ in the bud may finish the shaping of the whole.

We can see that the flowers of the Kew race are a little more knitted into an unit than those of the German races. Thus the petals and sepals are much more often equal in number, and (as is shown on p. 103) when we get a flower of the Kew race departing in the sepals from normal by losing one, then the other organs are more likely to lose in proportion than in the German races. In short there is more see-sawing of mood on mood in the German races than in the Kew race.

However there are irregularities in the curves with which I have been dealing which cannot clearly be attributed to the struggling of the moods for satiety and their relative advantages from primogeniture. These are made obvious in the recast table XV which we now have in XXVI.

The chief irregularities of the Kew race are:—

(i)—Between 15 and 20 the stamens are above what would seem reasonable, rather more so at 15, 16, 18 and 19 than at 17 and 20.

(ii)—At 23 the stamens are a little above what would seem reasonable, the carpels below.

I do not intend to attempt any explanation of these facts, but I must observe that if we cut out of our figures all flowers which have both their sepals and their petals other than five in number, the irregularities just noted almost disappear: and they do not disappear if we cut out only those flowers with sepals other than five: and this indicates that between 15 and 20 the stamens are able to add to their number from the petals. This is done in table XXVII.

Table XXVI.—Percentages of organs in the Kew race falling to the different moods in flowers of various numbers of parts.

No. of Organs.	Kew, Old.				Kew, New.			
	Sepals.	Petals.	Stamens.	Carpels.	Sepals.	Petals.	Stamens.	Carpels.
8 ...	...	...	...	...	...	37·50	12·50	50·00
9 ...	...	...	...	...	...	...	...	...
10 ...	...	...	...	...	20·00	30·00	40·00	10·00
11 ...	38·64	15·91	22·73	22·73	...	...	...	...
12 .	33·33	25·00	29·17	12·50	28·33	25·00	28·33	18·33
13 ..	31·32	21·98	23·62	23·08	28·96	21·26	26·24	23·53
14 ...	33·70	20·76	24·33	21·20	32·14	20·36	26·43	21·07
15 ..	31·31	21·01	26·87	20·80	28·57	22·38	27·62	21·43
16 ..	30·08	26·39	27·11	22·42	29·43	19·88	27·61	23·07
17 ...	28·95	21·89	26·70	22·45	28·64	19·57	27·48	24·30
18 ..	27·51	22·18	27·73	22·57	27·18	20·37	27·59	24·85
19 ...	26·22	22·42	27·72	23·63	26·19	21·70	26·70	25·49
20 ...	24·96	23·00	27·36	24·66	25·00	22·59	26·72	25·68
21 ...	23·73	22·93	28·53	24·79	23·71	22·47	27·75	26·02
22 ...	22·69	22·08	29·78	25·46	22·72	21·89	28·95	26·45
23 ...	21·72	21·58	31·85	24·86	21·64	21·15	31·02	26·[illegible]9
24 ..	20·83	20·61	32·97	25·58	20·79	20·52	32·00	26·68
25 ...	19·96	19·71	34·53	25·78	20·00	19·59	33·50	26·89
26 ...	19·23	18·97	36·70	25·09	19·19	19·19	34·87	26·76
27 ..	18·47	18·43	38·09	25·00	18·52	18·37	36·45	26·65
28 ..	17·81	17·81	39·47	24·88	17·85	17·80	38·49	25·84
29 ...	17·24	17·18	41·70	23·87	17·24	17·24	39·79	25·72
30 ...	16·66	16·66	42·59	24·07	16·66	16·53	40·95	25·85
31 ...	16·13	16·01	43·39	24·47	16·20	16·05	42·62	25·11
32 ...	15·63	15·63	44·86	23·88	15·62	15·43	44·14	24·80
33	15·16	15·16	45·87	23·84	15·15	14·72	45·89	24·24
34 ...	14·70	14·70	46·32	24·26	13·73	13·73	48·04	24·51
35 ...	14·28	14·28	45·71	25·71	14·29	14·29	45·71	25·71
36 ...	...	...	...	...	13·89	13·89	44·44	27·77

Table XXVII.—Percentage of stamens present in flowers with sepals and petals any number, with sepals 5 and petals any number, and with both sepals and petals 5.

Total organs.		14	15	16	17	18	19	20	21	22	23	24
Kew, Old	All flowers ...	24·33	26·87	27·11	26·70	27·73	27·72	27·36	28·53	29·78	31·85	32·97
	Flowers with K5 ...	24·41	25·72	26·68	26·56	27·65	27·68	27·29	28·38	29·72	31·84	32·99
	Flowers with K5 C5 ..	...	13·33	25·00	21·27	23·61	24·54	25·66	27·76	29·22	31·36	36·62
Kew, New	All flowers ...	26·43	27·62	27·61	27·48	27·59	26·70	26·72	27·75	28·95	31·02	32·00
	Flowers with K5 ...	25·60	25·34	26·64	27·10	27·27	26·65	26·72	27·61	28·95	30·93	31·92
	Flowers with K5 C5 ..	...	...	...	14·71	22·22	23·80	25·16	26·57	28·44	30·43	31·44

Now it comes about from this tendency of stamens to gain below 20 in percentage at the expense of the petals, and from the tendency of the carpels above 20 to show satiety, that the excess of stamens over carpels is likely to be least at 20 and greater both above and below that number. Thus is the sex-proportion continually shifting along our curves.

Half staminodal petals were found in flowers of the Kew race as follows; it will be noticed that towards the end of the flowering period they appeared but one at a time in the flowers.

Table XXVIII.—Half Staminodal petals.

		Period 1	2	3	4
Kew, Old ...	Number	7	30	20	19
	In flowers	3	23	18	19
	Percentage	·47	·76	·79	·75
Kew, New ...	Number	9	16	11	14
	In flowers	5	·63	11	14
	Percentage	·72	·63	·61	·85

Lastly I have an abnormality to notice; it consists of a lobing of the petals, one lobe being larger than the other. I found this abnormality in the Kew race to be fairly frequent and further I found it to be most abundant when the number of staminodes was highest.

Table XXIX.—Lobed petals.

		Period 1	2	3	4
Kew, Old ...	Number	10	30	21	19
	In flowers	2	17	16	9
	Percentage	·605	·756	·839	·753
Kew, New ...	Number	5	17	13	7
	In flowers	3	16	12	6
	Percentage	·399	·674	·721	·427

Summary.

I have shown first of all (Tables I–IV) how the flowers of *Ranunculus arvensis* in the races studied, vary; and how each set of organs varies in a different way; so that the curves which may be plotted for sepals, for petals, for stamens, and for carpels are unlike, most of them neither perfect Quetelet-Galton nor perfect half Galton curves.

I have shown secondly (Tables V–XIV) that a correlative increase and decrease occurs between the different sets of organs; so that when the stamens or any other set of organs depart from normal, it is probable that all other sets of organs will depart from normal, but chiefly those which follow. This is important as it indicates a division of vigour among the various sets, to be distinguished from an increase of the one at the expense of another.

In Tables XV–XVI and in the graphic representation of them on page 106 I have followed this up by showing how if we take the total number of organs in the flower as a measure of the vigour in the bud, we find that the ring of sepals, being the first-formed of the sets of organs, has the first pull on the vigour and is most likely to get a full complement, the ring of the petals being the next in order, is the next to be satisfied, and that stamens and carpels obtain the surplus the stamens chiefly so. I consider that the curves might with some little trouble be translated into formulae by a mathematician.

In Tables XVII–XX, I show that the power to produce organs diminishes as the plant grows weaker towards its death. Sometimes a slight recovery occurred at the very end: I do not feel justified in suggesting a cause for it. In Tables XXI and XXII, I show that sterility of the stamens increases towards the death of the plant.

In Tables XXIII–XXV, I show that the stamens—the organs which profit chiefly as we have seen by the extreme of vigour—lose by its loss; and consequently the flowers are most male when blossoming begins.

In Table XXVI, I have represented Table XV in a different way, so as to bring out sharply the division of vigour (*i.e.*, number of organs) between the different sets (moods). I can show by it that the flowers with more than 20 organs, there apparently is a setting aside *ab initio* of so much vigour for the carpellary mood, the staminal mood becoming residuary legatee; while in flowers with fewer than 20 organs the carpellary mood has to jostle with the preceding ones for its place. I show also by it and by the Table which follows it (XXVII), that there are certain irregularities which seem to be due to a borrowing of organs by the staminal set from the petals, which borrowing as may be noticed in Table XII, (see p. 102) probably is a more common occurrence in the German races than in the Kew race.

The last two Tables (Nos. XXVIII and XXIX) show the relative abundance of abnormal petals and staminodal petals at different times in the plants flowering.

The net result of the investigation is that we have in *Ranunculus arvensis* just a little of what (for want of a better term) may be called foresight in the formation of the flower. We find the flower completed however scanty the nutrition for it may be; and, when the nutrition is adequate, provision is, it seems, made in good time for the carpellary mood. The next problem will be to show how far in such a flower as that of Parnassia or of any Phanerogam, the constancy of the carpels is due to provision made for them when the bud first begins to be formed. Can the sepaline mood lead the carpellary by the nose, or is the carpellary not too important to the race to be without an assertiveness of its own?

It is interesting to observe that the staminal mood forms a sort of residuary legatee to the three early moods of the flower; interesting because we not uncommonly find that mood to disappear under conditions which have generally been ascribed to something disadvantageous to the plant (see Willis, On Gynodiœcism, 3rd paper, *Proc. Cambridge Phil. Soc.*, viii., 1893, p. 129).

We have sought in passing for any indication in the flower which might suggest that pressure of organ on organ exercises an influence in shaping the flower; and we found that flowers of 20 organs did come near to having the formula $K_5C_5A_5G_5$: and in Table V we saw K_4C_4 and K_3C_3 to be commoner combinations than $K_4C_{3 \text{ or } 5}$ (especially 5) and $K_5\ C_4$ or indeed any other number, and in Tables VI and VIII ten stamens to be commoner than nine or eleven in association with five sepals or with five petals. These observations do not suffice for building up any very definite statement.

It is equally advisable at present from these tabulutions to make no statement regarding the possibility of female organs demanding per unit for their inception more nutriment than male organs.

One notices in regard to the variation of the flower of *Ranunculus arvensis* that it is always hungry, *i.e.*, always capable to taking in more organs; the hungriest of its moods is that for the formation of stamens, next that for the formation of carpels, thirdly that for petals and least hungry that for sepals.

Just as we find sepals to tend to be constant in number throughout our larger groups such as the Dicotyledons and Monocotyledons; petals to be constant in number in lesser groups; carpels to serve by their constancy for the defining of orders, and stamens to be by number the least serviceable in the making of a classification of Phanerogams, so do we find sepals to have the greatest tendency to be constant in *Ranunculus arvensis*, petals next so, carpels in the third place and stamens last, *i e.*, what we see in a broad view of the whole Phanerogamic Sub-Kingdom, we see again in the variation of the flower of this little weed.

I had intended to deal with variation in *Nigella sativa* and *Delphinium Ajacis*, when writing on *Ranunculus arvensis* but my facts, are insufficient. They may, however, be said to be indicative of a reduction in number of all parts with age. For the present I withhold them.

My thanks are cordially given to the Cambridge Botanic Garden Syndicate for the facilities afforded to me in the University Garden, and to all who have helped me. The tedious operation of casting my figures into tables has in Calcutta occupied the time for several months of a clerk, Babu Kanai Lall Das.

ZOOLOGY.

Wood, H. and Finn, F. On a c[illegible]tion of Birds from Upper Burmah. Calcutta, Journ. As. Soc. Bengal, LXXI, Pt. ii, 1902 (121-131).

Geographical notes... ... ... pp. 121-124.

List of species of the following families found in Upper Burmah.

Corvidae (p. 124) *Crateropodidæ* (pp. 124-126) *Sittidæ* (p. 126) *Dicruridae* (pp. 126-127) *Laniidæ and Oriolidæ* (p. 127) *Sturnidæ* (pp. 127-128) *Muscicapidæ, Turdidæ, Fringillidæ* (p. 128, *Nectariniidæ, Picidæ, Capitonidæ, Coraciidæ, Meropidæ* (p. 129) *Alcedinidæ* (pp. 129-130) *Bucerotidæ, Upupidæ, Cuculidæ, Psittacidæ, Asionidæ* (p. 130) *Falconidæ* (pp. 130-131) *Phasianidæ, Charadriidæ* (p. 131).

Birds, new to Indian Fauna, found in Upper Burmah.

Babax lanceolatus, and *Parus palustris* (p. 121).

Rare birds from Upper Burmah.

Trochalopterum erythrolaema (p. 121) *Phasianus humiae* (p. 131).

Sanyal, R. B. Notes on animals observed at the Alipore Zoological Garden, No. 2. A brief note on the "Doctrine of Telegony" with reference to facts observed in the Zoological Gardens, Calcutta. Calcutta, Journ. As. Soc. Bengal, LXXI, Pt. ii, 1902 (132). Telegony in *Bos sondaicus*, p. 132.

Mann, Harold H. Notes on a disputed point in the Life-History of *Helopeltis theivora*. Calcutta, Journ. As. Soc. Bengal, LXXI., Pt. ii, 1902 (133-134).

Non-hibernation of *Helopeltis theivora*, pp. 133-134, cold weather habits of „ „ p. 134.

Finn, F. On a pair of abnormal Deer Horns. Calcutta, Journ. As. Soc. Bengal, LXXI, Pt. ii, 1902 (135-137, with 2 figs.)

Cervus unicolor, abnormal horns, p. 135.

Sanyal, R. B. Notes on Animals observed at the Alipore Zoological Garden, No. III. Melanic specimens of Common Palm Squirrel (*Sciurus palmarum*, Linn.) Calcutta, Journ. As. Soc. Bengal, LXXI, Pt. ii, 1902 (137-138). Melanic variation of *Sciurus palmarum*, pp. 137-138.

GEOLOGY.

Oldham, R. S. On Tidal periodicity in the Earthquakes of Assam. Calcutta, Journ. As. Soc. Bengal, LXXI, Pt. ii, 1902, 139-153 (tables and curves of frequency).

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ZOOLOGY.

Finn, F. General notes on variation in Birds. Calcutta, Journ. As. Soc. Bengal, LXXI, Pt. ii, 1902 (154-184).

Variation in structural characters	pp. 154-155
Colour variation in wild birds	155-158
Reversion to normal colour in abnormal varieties ...	p. 158
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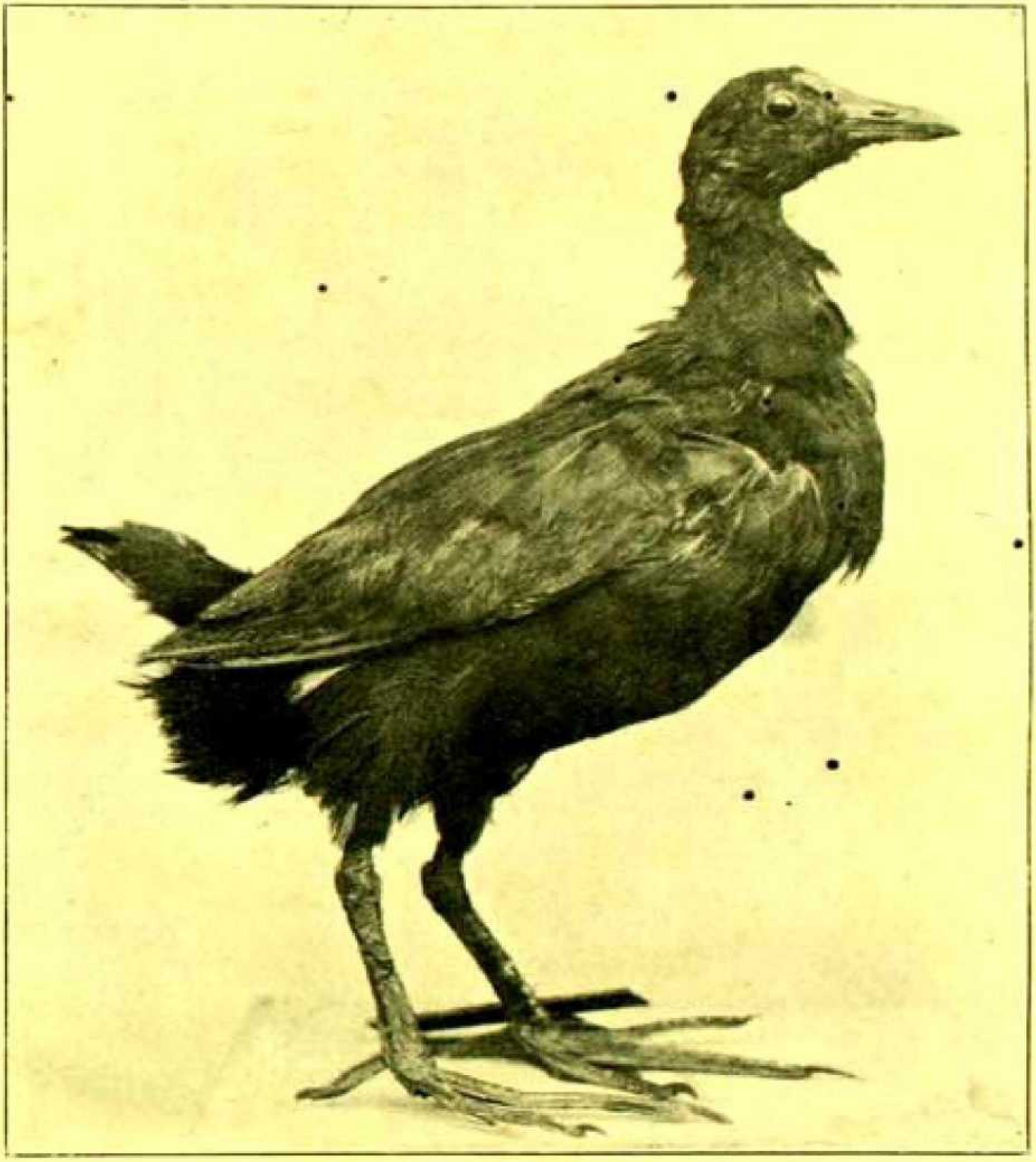
PLATE IV.



GALLINULA PYRRHORHOA (*Blyth's Mauritius Specimen*).

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X.—*On a collection of Birds from Upper Burmah.—By* LIEUT. H. WOOD, R.E., *and* F. FINN, B.A., F.Z.S., *Deputy Superintendent of the Indian Museum.*

(With Plate VII.)

[Received 30th April. Read 7th May, 1902.]

In the following paper Lieut. Wood is responsible for the general introduction and remarks on localities where the birds were collected; while the birds have been identified and annotated at the Indian Museum by the Deputy Superintendent. Almost all of the specimens have been generously presented to that institution by Lieut. Wood, and the accession is a particularly welcome one, as several rare species are represented, such as *Trochalopterum erythrolaema*.

The collection is also noteworthy as containing examples of two species new to the Indian fauna, Père David's Babbler (*Babax lanceolatus*) and the Marsh Tit (*Parus palustris*). It has been deemed worth while to have these figured, on account of their interest from a distributional point of view. (See Plate VII).

The collection was made in that part of Burmah which is bounded on the west by the high range which divides the Pakokku and Minbu districts from the Chin Hills, and on the east by a parallel range which runs more or less due north and south, distant about 30 miles, and known locally under different names as the Pontaung

Nwamataung, Dudwataung, &c. Latitude 22° formed approximately the northern boundary and 20°15′ the southern. A few specimens were however procured outside this tract while marching from Pakokku, the headquarters of the district of that name and situated on the River Irrawaddy.

The country within the boundaries described above is hilly, the average height of the eastern range being about 1,500 feet while some of the peaks are higher.

From this range the country is broken up by a number of smaller ranges, each slightly lower till the foot of the western range is reached. Along the foot of the eastern slopes of this range there is nearly always a large river which breaks through the range and then turns immediately due north or south and flows in this direction for some distance till it finds a low place in the eastern range through which it can pass. The Maw, Man, Salin and Moṇ Rivers are all met in this way. The western range is much higher than those to the east. The average height being about 5,000 to 6,000 feet, while Mount Victoria (the highest peak in Burmah, 10,300 feet) is one of the peaks on the range within the limits. The country is heavily forested except in the valleys of the main streams, where rice is principally grown.

Pakokku, Long. 95°10′, Lat. 21°18′, height 300 feet. The headquarters of the district of that name. It is situated on the west bank of the Irrawaddy River and is in the dry zone of Upper Burmah. Outside the cultivation which surrounds the town, the country is covered with scrub jungle.

Kanhla, Long. 95°2′, Lat. 21°17′, height 400 feet. A small village on the Pakokku-Pauk Road; surrounding country scrub jungle.

Pauk, Long. 94°30′, Lat. 21°29′, height about 900 feet. A large village on the Pakokku-Tilin cart-road, situated just to the east of the first high range met with while marching west from the Irrawaddy River. The Yaw River flows about a mile to the east of the village. Outside the cultivation there is scrub jungle which gradually changes to forest as the hills are approached. It is on the west edge of the "dry zone"

Kyin, Long. 94°18′, Lat. 21°37′, height about 2,000 feet. A small village on the Pauk-Tilin cart-road, situated to the westward of the first high range which is met with while marching westward from the Irrawaddy River. A small area of cultivation surrounds the village; beyond this is dense forest.

Ta-hnyin-taung, Long. 94°15′, Lat. 21°37′, height about 2,500 feet. A spur running westwards from the first high range met with while going west from the Irrawaddy. This high range is known locally under a number of different names but it runs more or less along meridian of 94°20′. It is covered with dense forest.

Tilin, Long. 94°8′, Lat. 20°13′, height about 1,500 feet. A large village at the foot of the Chin Hills on the right bank of the Maw River. The cart-road to Gangaw from Pakokku passes through the village. Outside the cultivation the country is covered with dense jungle.

Man, Long. 94°17′, Lat. 21°18′, height about 1,600 feet. A small village on the Pauk-Pasok cart-road, situated to the west of the first high range met with while going west from the Irrawaddy. The village is surrounded by dense jungle outside the small patch of cultivation.

Pontaung, Long. 94°18′, Lat. 21°20′, height 1,900 feet. The first high range met with while going west from the Irrawaddy; on the lower slopes the forest is principally bamboo, which gradually changes into timber trees (teak, etc.), as the range rises in height.

Laungshé, Long. 94°10′, Lat. 21°0′, height about 1,000 feet. A large village situated at the foot of the Chin Hills just where the Salin River breaks through. A good deal of rice is cultivated in the valley and it was on the cultivation that most of the birds were shot here.

Kanpetlet, Long. 94°0′, Lat. 21°14′, height 7,000 feet. At this place on the slopes of Mount Victoria the headquarters of the Pakokku Chin Hills are being built. It at present consists of two or three houses, while barracks for about 60 sepoys are being built. Mount Victoria, the summit of which is 10,300 feet, is the highest hill in Burmah and is the culminating point of the high range which runs from Manipur southwards more or less along the meridian of 94°. A long spur emanates from the summit running in an easterly direction, and it is on this spur that Kanpetlet is situated. In the valleys the forest is very dense, while on the spurs there are large open spots covered with grass alternating with tracts of fairly open fir forest. Birds labelled Mount Victoria were shot on the way up to Kanpetlet from Saw, the village at the foot of the spur.

Dudawtaung, Long. 94°18′, Lat. 21°5′, height about 2,000 feet. A range of hills about 2,000 feet high running north and south, the first high one that is met while marching west from the Irrawaddy River. It is covered with fairly dense forest.

Yinkwètaung, Long. 93°58′, Lat. 20°44′, height 5,500 feet. The local name of one of the spurs which run eastward from the high range which forms the boundary between Pakokku district and the Chin Hills. Near the summit the spurs are bare of trees and covered with grass. In the valleys and on spurs below about 5,000 feet there is dense jungle.

Nwamataung, Long. 94°18′, Lat. 20°4′, height about 2,500 feet. A local name of the same range which to the north is known as Dudawtaung.

Salin, Long. 94°44′, Lat. 20°35′, height 250 feet. A large village on the Salin River about 10 miles on the west of the Irrawaddy River. It is in the dry zone and outside the cultivation is scrub jungle.

Sidôktaya, Long. 94°15′, Lat. 20°25′, height 2,000 feet. A large village situated at the foot of the Chin Hills on the bank of the river Mon. A large area of cultivation lies to the east of the village, while to the westward dense jungle comes very close.

Dalet Choung, Long. 94°0′, Lat. 20°10′, height 300 feet. A river which rises in the Arakan Yomas and flows due south reaching the sea between Akyab and Kyaukpyu. The surrounding hills are all densely covered with bamboo jungle.

Family **Corvidæ.**

UROCISSA OCCIPITALIS. *Red-billed Blue Magpie.*

Two, Laungshé, January 11th, 1902; one, Kyin Village, November 30th, 1901.

DENDROCITTA RUFA. *Indian Tree-pie.*

One, Laungshé, January 12th, 1902; one, Man, December 25th, 1901.

CRYPSIRRHINA CUCULLATA. *Hooded Racket-tailed Magpie.*

One, Sidôktaya, February 14th, 1902.

GARRULUS OATESI. *Indo-Chinese Jay.*

One, Kanpetlet, January 3rd, 1902.

PARUS PALUSTRIS. *Marsh-Tit.*

One, Kanpetlet, January 14th, 1902.

This specimen undoubtedly belongs to one of the races of *P. palustris.* The dimensions are rather large, the length being 4·9 inches, wing 2·5, tail 2·1, bill from gape ·4, and shank nearly ·6. The colour above is olive grey, or drab; below a dirty drab-white. The cap and nape are glossy black, and the sides of head and neck pure white; the throat black with white tips to the feathers. The bill and feet are greyish black in the skin.

[The specimen agrees perfectly with some Chinese specimens of *P. palustris,* recently procured by Captain Walton, I.M.S.]

Family **Crateropodidæ.**

GARRULAX LEUCOLOPHUS, *Himalayan White-Crested Laughing-Thrush.*

Two, Laungshé, January 12th, 1902.

GARRULAX PECTORALIS. *Black-gorgeted Laughing-Thrush.*

One, Dudawtaung, December 26th, 1901; one, Laungshé, January 11th, 1902. The latter has the under-surface buff throughout up to the chin. Both have the light tips to the tail-feathers pure white.

GARRULAX MONILIGER. *Necklaced Laughing-Thrush.*

One, Ta-hnyin-taung, December 10th, 1901.

The ear-coverts of this bird are *entirely* black; tips of tail pure white.

BABAX LANCEOLATUS. *Père David's Streaked Babbler.*

One, Kanpetlet, January 4th, 1902.

As this bird does not seem to be well known, I give a description of the specimen. Length about 11¼ inches; wing 3″·8; tail 5; bill from gape 1·1; shank at front 1·2.

Plumage striated, with the exception of the visible parts of the wings and tail, which are plain olive, as also the upper tail-coverts. Centres of the feathers above blackish, shading into chestnut on each side, with the outsides edged on the neck with creamy white and on the back with olive. Lores, ear-coverts, and eye-brow, white slightly mixed with black; a strong black moustache running into a mottled black-and-white patch behind the ear-coverts. Under-surface creamy white streaked with black, the black streaks getting finer upwards and fading out on the throat, and becoming bordered with chestnut on the flanks; lower tail-coverts plain buff.

From the descriptions and figures of David and Oustalet (Oiseaux de Chine) J. Verreaux (Nouv. Arch. du Museum, Bull. VII, 1871) and Dr. R. B. Sharpe (B.M. Cat. Birds, Vol. VII.), *Babax lanceolatus* would appear to have a uniformly chestnut head, the dorsal plumage edged with grey, not olive, and the ventral surface less striated than in our bird, in which also the tarsi seem considerably shorter.

At the same time, without specimens for comparison, I do not like to regard the present bird as deserving of specific distinction; if it be so I would propose the name of *Babax woodi* for it.

TROCHALOPTERUM ERYTHROLÆMA. *Hume's Laughing-Thrush.*

Two, Yinkwètaung, January 19th, 1902; one, same locality, January 20th, 1902.

TROCHALOPTERUM VIRGATUM. *Manipur Striated Laughing-Thrush.*

One, Kanpetlet, January 3rd, 1902; one, Kanpetlet, January 4th, 1902.

ARGYA GULARIS. *White-throated Babbler.*

Two, Pakokku, November 19th, 1901.

MYIOPHONEUS TEMMINCKII. *Himalayan Whistling-Thrush.*

One, Yinkwètaung, January 27th, 1902.

LIOPTILA GRACILIS. *Grey Sibia.*

One, Yinkwètaung, January 18th, 1902; two, January 27th, 1902; one without date or locality.

AEGITHINA TIPHIA. *Common Iora.*

One, Pakokku, November 21st, 1901; one, Pauk, November 27th, 1901; one no date or locality.

CHLOROPSIS AURIFRONS. *Gold-fronted Chloropsis.*

One, Ta-hnyin-taung, November 8th, 1901; one, same locality, December 2nd, 1901; one, same locality, December 10th; one, Man, December 14th; one, same locality, December 20th; one, same locality, December 24th; one, Dudawtaung, January 7th, 1902.

CHLOROPSIS CHLOROCEPHALA. *Burmese Chloropsis.*

One, Ta-hnyin-taung, no date; one, same locality, December 3rd, 1901.

HYPSIPETES PSAROIDES. *Himalayan Black Bulbul.*

One, Yinkwètaung, January 29th, 1902.

HEMIXUS MACLELLANDI. *Rufous-bellied Bulbul.*

One, Yinkwètaung, November 2nd, 1901; two, same locality, January 18th, 1902; one, same locality, January 19th; one, same locality, January 27th; one, same locality, no date available.

ALCURUS STRIATUS. *Striated Green Bulbul.*

One, Yinkwètaung, January 20th, 1902.

MOLPASTES BURMANICUS. *Burmese Red-crested Bulbul.*

One, Tilin, December 12th, 1901.

XANTHIXUS FLAVESCENS. *Blyth's Bulbul.*

One, Kanpetlet, January 4th, 1901.

OTOCOMPSA FLAVIVENTRIS. *Black-crested Yellow Bulbul.*

One, no data; one, Ta-hnyin-taung, December 3rd, 1901; one, same locality, December 6th.

Family **Sittidæ.**

SITTA HIMALAYENSIS. *White-tailed Nuthatch.*

One, Yinkwètaung, January 20th, 1902.

SITTA NAGAENSIS. *Austen's Nuthatch.*

One, Kanpetlet, January 4th, 1902.

SITTA FRONTALIS. *Velvet-fronted-Blue Nuthatch.*

Two, Ta-hnyin-taung, December 7th, 1901; one, Man, December 25th.

Family **Dicruridæ.**

DICRURUS ATER. *Black Drongo.*

One, Pakokku, November 23rd, 1901; a decidedly small specimen.

DICRURUS CINERACEUS. *Grey Drongo.*

One, Ta-hnyin-taung, December 8th, 1901.

BHRINGA REMIFER. *Lesser Racket-tailed Drongo.*

One, Ta-hnyin-taung, December 8th; one, same locality, December 10th.

DISSEMURUS PARADISEUS. *Larger Racket-tailed Drongo.*

One, Ta-hnyin-taung, December 5th, 1901; one, no locality.

Family **Lanidæ.**

LANIUS COLLURIOIDES. *Burmese Shrike.*

One, Pakokku, November 19th, 1901; one, Yinkwetaung, February 2nd, 1902. The first specimen has the *two* outer pairs of tail-feathers white with black shafts, and the *next* pair white with a long black patch on the inner web, the rest being black tipped with white; the under-parts are also very pale, creamy white in fact. The dimensions are also smaller than those given in the *Fauna of British India*, Vol. I, p. 463. The crown and nape are dark ashy, and the forehead and lores black. The second has the tail normally coloured, and pale fulvous under-parts.

TEPHRODORNIS PELVICUS. *Nepal Wood-shrike.*

One, Ta-hnyin-taung, December, 1901.

PERICROCOTUS FRATERCULUS. *Burmese Scarlet Minivet.*

One, Ta-hnyin-taung, November 4th, 1901; two, same locality December 4th; one, Pauk, November 27th, 1901; one, Mt. Victoria, December 30th; one, Kanpetlet, January 4th, 1902.

PERICROCOTUS BREVIROSTRIS. *Short-billed Minivet.*

One, no locality or date; one, Kanpetlet, January 4th, 1902.

PERICROCOTUS PEREGRINUS. *Small Minivet.*

Three, Man, December 22nd, 1901; one, Pauk-Tilin Road, November 29th, 1901.

Family **Oriolidæ.**

ORIOLUS TENUIROSTRIS. *Burmese Black-naped Oriole.*

One, Pauk, November 27th, 1901.

ORIOLUS MELANOCEPHALUS. *Indian Black-headed Oriole.*

One, Ta-hnyin-taung, December 4th, 1901; one, same locality, December 8th; one, Pakokku, 22nd November; one, Tanksoh, February 9th, 1902; one, Man, December 22nd, 1901; one, Dudawtaung, January 7th, 1901.

Family **Sturnidæ.**

GRACULIPICA BURMANICA. *Jerdon's Mynah.*

One, Pakokku, November 20th, 1901; one, no date.

The birds referred to *Sturnia nemoricola* in J. A. S. B. 1900, pt. II. p. 116 are, I find, of this species; at least the four specimens kindly presented by Colonel Bingham to the Museum belong to it.

Family **Muscicapidæ**.

Cyornis rubeculoides. *Blue-throated Flycatcher.*

One, Ta-hnyin-taung, December 2nd, 1901; one, Pontaung, February 2nd, 1902.

Culicicapa ceylonensis. *Grey-headed Flycatcher.*

One, Ta-hnyin-taung, December 8th, 1901.

Rhipidura albifrontata. *White-browed Fantail Flycatcher.*

One, Pakokku, November 20th, 1901.

Family **Turdidæ**.

Pratincola caprata. *Common Pied Bush-chat.*

Three, Pakokku, November 19th, 20th and 21st, respectively; one, Laungshé, January 12th, 1902.

All have the black plumage fringed throughout with fulvous, except the bird killed on November 21st, which shows no such edgings at all except a few barely perceptible specks on the belly.

Copsychus saularis. *Magpie-Robin.*

One, Pakokku, November 21st, 1901.

This is by plumage a female, and has the fulvous parts of the under-surface finely cross-barred with a lighter shade.

Petrophila erythrogastra. *Blue-headed Rock-Thrush.*

One, Kanpetlet, January 3rd, 1902; two, same locality, following day.

Petrophila solitaria. *Eastern Blue Rock-Thrush.*

One, Pakokku, November 11th, 1901.

Not typical, but only showing a little chestnut on the under-tail coverts.

Petrophila cyanus. *Western Blue Rock-Thrush.*

One, Dudawtaung, January 7th, 1902; one, Laungshé, January 11th; one, Nwamataung, February 2nd, 1902. The last shows one red under-tail covert.

Oreocincla dauma. *Small-billed Mountain-Thrush.*

One, Dudawtaung, January 8th, 1902.

Family **Fringillidæ**.

Passer flaveolus. *Pegu House-Sparrow.*

One, Pakokku, November 21st, 1901; one, same locality, November 23rd.

Family **Nectariniidæ.**

ARACHNECHTHRA ASIATICA. *Purple Sun-bird.*

One, Salin, February 4th, 1902.

Family **Picidæ.**

GECINUS OCCIPITALIS. *Black-naped Green Woodpecker.*

One, Pakokku, November 19th, 1901; one, Man, December 24th.

HYPOPICUS HYPERYTHRUS. *Rufous-bellied Pied Woodpecker.*

One, Kanpetlet, January 4th, 1902.

IYNGIPICUS CANICAPILLUS. *Burmese Pigmy Woodpecker.*

One, Ta-hnyin-taung, December 4th, 1901; one, same locality, December 7th; one, Dudawtaung, January 7th, 1902.

TIGA SHOREI. *Himalayan Golden-backed Three-toed Woodpecker.*

Two, Ta-hnyin-taung, killed on December 5th and 7th, respectively. Both have the rudimentary hallux previously described by me as characteristic of this species. (J. A. S. B. 1899, pt. II. p. 242).

CHRYSOCOLAPTES GUTTICRISTATUS. *Tickell's Golden-backed Woodpecker.*

One, Ta-hnyin-taung, December 11th, 1901.

This specimen, a male by plumage, has the red of the rump running right up to the shoulders, but shows none on the wings or scapulars.

Family **Capitonidæ.**

THEREICERYX LINEATUS. *Lineated Barbet.*

Three, Ta-hnyin-taung, December 2nd, 4th and 5th, respectively; one, Pontaung, December 21st.

CYANOPS ASIATICA. *Blue-throated Barbet.*

One, Ta-hnyin-taung, December 4th, 1901.

Family **Coraciidæ.**

CORACIAS AFFINIS. *Burmese Roller.*

One, Pakokku, November 20th, 1901; two, Laungshé, January 12th, 1902; one, Man, December 26th, 1901.

Family **Meropidæ.**

MEROPS VIRIDIS. *Common Indian Bee-eater.*

One, Pakokku, November 20th, 1901; one, no date.

Both very rufous on head, nape and upper back.

Family **Alcedinidæ.**

CERYLE VARIA. *Indian Pied Kingfisher.*

One, Pakokku—Pagan Road, November 25th, 1901.

HALCYON SMYRNENSIS. *White-breasted Kingfisher.*

One, Pakokku, November 20th, 1901; one, Kanhla, November 21st; one, Laungshé, January 12th, 1902.

Family **Bucerotidæ.**

ANTHRACOCEROS ALBIROSTRIS. *Indo-Burmese Pied Hornbill.*

One, Dalet Choung, February 27th, 1902. A small specimen, but rather over the measurements given in the *Fauna of British India* for the smaller race of this species.

Family **Upupidæ.**

UPUPA INDICA. *Indian Hoopoe.*

One, Ta-hnyin-taung, December 6th, 1901.

Family **Cuculidæ.**

RHOPODYTES TRISTIS. *Large Green-billed Malkoha.*

Two, Kyin Village, November 30th, 1901; two, of which the data are illegible, all the specimens being very greasy, and mostly unfit to keep. All possess eyelashes, although the genus is stated (F.B.I. Birds, Vol. III, p. 230), to want these.

CENTROPUS SINENSIS. *Common Coucal or Crow-Pheasant.*

One, Man, December 6th, 1901.

Family **Psittacidæ.**

PALÆORNIS TORQUATUS. *Rose-ringed Paroquet.*

One, Pakokku, November 22nd, 1901; one, Pauk-Tilin Road, November 29th.

PALÆORNIS FASCIATUS. *Red-breasted Paroquet.*

One, Pakokku, November 21st, 1901.

Family **Asionidæ.**

ATHENE BRAMA. *Spotted Owlet.*

One, Pakokku, November 19th, 1901.

Family **Falconidæ.**

SPILORNIS CHEELA. *Crested Serpent-Eagle.*

A pair of feet with a few feathers attached clearly belong to this species.

BUTASTUR TEESA. *White-eyed Buzzard-Eagle.*

One, Pakokku-Pauk, November 24th, 1901.

HALIASTUR INDUS. *Brahminy Kite.*

One, Pakokku, November 22nd, 1901.

FALCO JUGGER. *The Laggar Falcon.*

One, Pakokku, November 22nd, 1901.

A beautiful adult example of this species.

TINNUNCULUS ALAUDARIUS. *Kestrel.*

One specimen without data.

MICROHIERAX EUTOLMUS. *Red-legged Falconet.*

One, Ta-hnyin-taung, December 9th, 1901.

Family **Phasianidæ.**

PHASIANUS HUMIÆ. *Mrs. Hume's Pheasant.*

One specimen obtained at Kanpetlet, January 2nd, 1902. This is by plumage a male, and is of the typical Manipur form with steel-blue rump-feathers narrowly edged and barred with white. Only the front of the neck, however, is steely-*black*, the sides and back of the neck being steely-*grey*, contrasting with the colour of the throat and breast.

GENNÆUS sp. ?

One female specimen obtained at Yinkwètaung on February 2nd 1902, most closely agrees with Mr. Oates' description of what he calls (Manual of the Game-Birds of India, Vol. 1, p. 365,) the North-Arrakan Silver Pheasant; but it has the *two* centre pairs of tail feathers chestnut with dark brown pencillings, the rest being black with chestnut pencillings progressively diminishing to the outermost feathers.

ARBORICOLA INTERMEDIA. *Arrakan Hill Partridge.*

One, Yinkwètaung, January 27th, 1901.

Family **Charadriidæ.**

HOPLOPTERUS VENTRALIS. *Indian Spur-winged Lapwing.*

One, Kanhla, November 24th, 1901.

AEGIALITIS DUBIA. *Little Ringed Plover.*

One, Pakokku, November 11th, 1901.

XI.—*Notes on Animals observed at the Alipore Zoological Garden, No. 2. A brief note on the "Doctrine of Telegony" with reference to facts observed in the Zoological Gardens, Calcutta.*—*By* RAI R. B. SANYAL, BAHADUR, *Superintendent.*

[Received April 29th. Read May 7th, 1902.]

The doctrine of telegony as it is understood in Europe and Australia is practically unknown in India.

There is a vague notion among some of the cattle-breeders, especially in parts of Bengal and Behar, that when first covered, a heifer ought to have a high-class bull for its mate.

Be that as it may, no scientific experiments, as far as I am aware have ever been undertaken in India to test the correctness or otherwise of the doctrine to which I have alluded.

I have ventured to bring the following facts to the notice of the Society, not so much for the sake of throwing any light on the subject, especially as Professor Cossar Ewart has already, after a series of careful experiments, proved that there is no equine telegony, but as they were the results of experiments in which a most interesting species of wild cattle was concerned.

In 1898 the Zoological Gardens, Calcutta, came in possession of a small herd of Bantengs (*Bos sondaicus* Müller and Schleg.) a species of wild cattle which mostly inhabit the plains of Burma and the Malay Peninsula and the islands of Borneo, Java, and Bali. One of the heifers was covered by an ordinary country male, which, though not a Brahmin bull as it is ordinarily understood in India, was a sturdy young bull of a very superior character. The offspring of this pairing was a healthy brindled male calf, which already promises to be a fine bull. The opportunity which this occurrence presented of examining the theory of telegony by futher experiments was duly taken advantage of, and the dam of the brindled calf was mated, in proper time, with a healthy bull of its own species. The offspring of this union was a pure bred Banteng calf without any traces of the previous strain. The same cow has had a second pure-bred calf lately.

XII.—*Note on a disputed point in the Life-History of* Helopeltis theivora. —*By* Harold H. Mann, B.Sc.

[Received April 30th ; Read May 7th, 1902.]

As is well known, *Helopeltis theivora*,—the "Tea Bug of Assam" as it was called by Mr. Wood-Mason, the "Mosquito Blight" as it is generally termed—is the most alarming pest which has yet appeared on tea cultivated in India. It causes the more disquietude as it tends to increase as years go by,—fluctuating according to season, but generally increasing, and invading new areas. During 1901, which was a particularly bad year in almost all districts subject to the pest, a very moderate estimate gives seven lakhs of rupees as the nett loss to the Indian Tea Industry from this cause alone.

Though we have a knowledge, thanks to Peal,* Wood-Mason,† Dudgeon,‡ Watt§ and Green,¶ of the general life-history of the insect from the egg to the adult stage, yet there remain several points which have been very obscure. Of these the most important is the question as to what becomes of the insect during the time when it apparently disappears from the tea bush. So complete is this disappearance, as a rule, that most planters living in affected districts in North-East India have hardly ever seen a single insect during January, February and March. Mr. Dudgeon has suggested that it hibernates in the ground, but offers no evidence for his position, and declares frankly that he had not been able to verify his conjecture. It has also been supposed that hibernation takes place in water and swamps, but again, not a scrap of evidence in favour of the view exists, and the same may be said of the very general idea among tea planters that in the cold weather the *Helopeltis* goes on to various jungle trees.

With a view of acquiring information on this point, I have spent a considerable time in January, February and March of the present year in two of the districts most affected by the pest—the Darjeeling-Terai, and Cachar—at a period when the insect was supposed to be hibernating. As a result I have come to conclusions of which the following is a summary.

The *Helopeltis theivora* can be found on the tea bush in every stage of development during every period of the year. The cold weather kills off the bulk of the mature insects and practically all the larvæ, but at all times sufficient remain to carry on the pest to the next season, and in addition the bushes are full of eggs. These latter were found not only in the usual position on the young shoot, but also at a much lower part of the bush than has previously been noticed, embedded in the usual fashion in the midrib of the large mature leaves. The larvæ were found on 11th January in small numbers on unpruned and sheltered bushes, then forming about 2½ per cent. of the total number of insects caught. By 12th February, however, a very different proportion of adults and larvæ were obtained, and now instead of 2½ per cent. the larvæ formed 80 per cent. of the total catch. This proportion was approximately kept up during several weeks from that date. The difficulty in obtaining evidence of their presence at this time is due to their attacking almost entirely the slightly shaded young leaves, the surface growth being rarely injured in the early part of the year.

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* Tea Cyclopedia, 1881.

† The Tea Bug of Assam, 1884.

‡ Indian Museum Notes. Vol. III pp. 33-38.

§ The Pests and Blights of the Tea Plant 1898.

¶ Royal Botanic Gardens, Ceylon. Circular, No. 21 (1st Series), 1901.

The insect could, further, not be found on any jungle plant at this time. Though jungle of very miscellaneous character was systematically searched, both by myself and by the children who are regularly catching the insect, and who are extremely expert at the work, not a single one was discovered in any form.

It appears, therefore, evident that there is, from present knowledge, no need to assume a hibernating stage at all for *Helopeltis theivora*, and that the insects remain and can be found in every stage of growth from the egg to the mature female full of eggs, in the tea-bush, at all times of the year. Whether the egg found low down in the bush, as described above, can be considered as a special hibernating egg, I can hardly say, but there certainly was no difference in structure or in method of deposition from that usual during the regular season. Inasmuch, then, as there is absolutely *no* evidence of the cold weather being passed by the insect in the soil, in water, or on other trees, and furthermore, as careful observation can always detect the insects and their eggs on tea bushes in affected districts, there is no need to imagine any hibernation stage at all in India, and beyond a certain retardation in development due to the reduced temperature, the reproduction of the insect may be considered to take place in a similar manner throughout the year, and to be carried out on the tea bush itself during the whole period.

These observations have a practical interest, and may lead to a sound method of attempting to deal with the pest, and experiments in this direction are now in progress.

XIII.—*On a pair of Abnormal Deer Horns.*—*By* F. Finn, B.A., F.Z.S., *Deputy Superintendent, Indian Museum.*

[Received May 28th; Read June 5th, 1902.]

I am indebted to His Highness the Maharajah of Cooch Behar, and to Mr. David Ezra (who procured me the loan of them) for the opportunity of exhibiting the very remarkable pair of antlers figured below.

As will be seen they resemble those of the Sambhar (*Cervus unicolor*) in general appearance and in their rough and deeply furrowed surface; but the terminations are much more branched than is usual in this species, which has only two terminal tines. In the present specimen there are no less than five terminal points, and the two horns are not at all alike, the branch representing the longer terminal tine in the normal horn being palmate or flattened in the left horn of this pair. (See figure on page 135.)

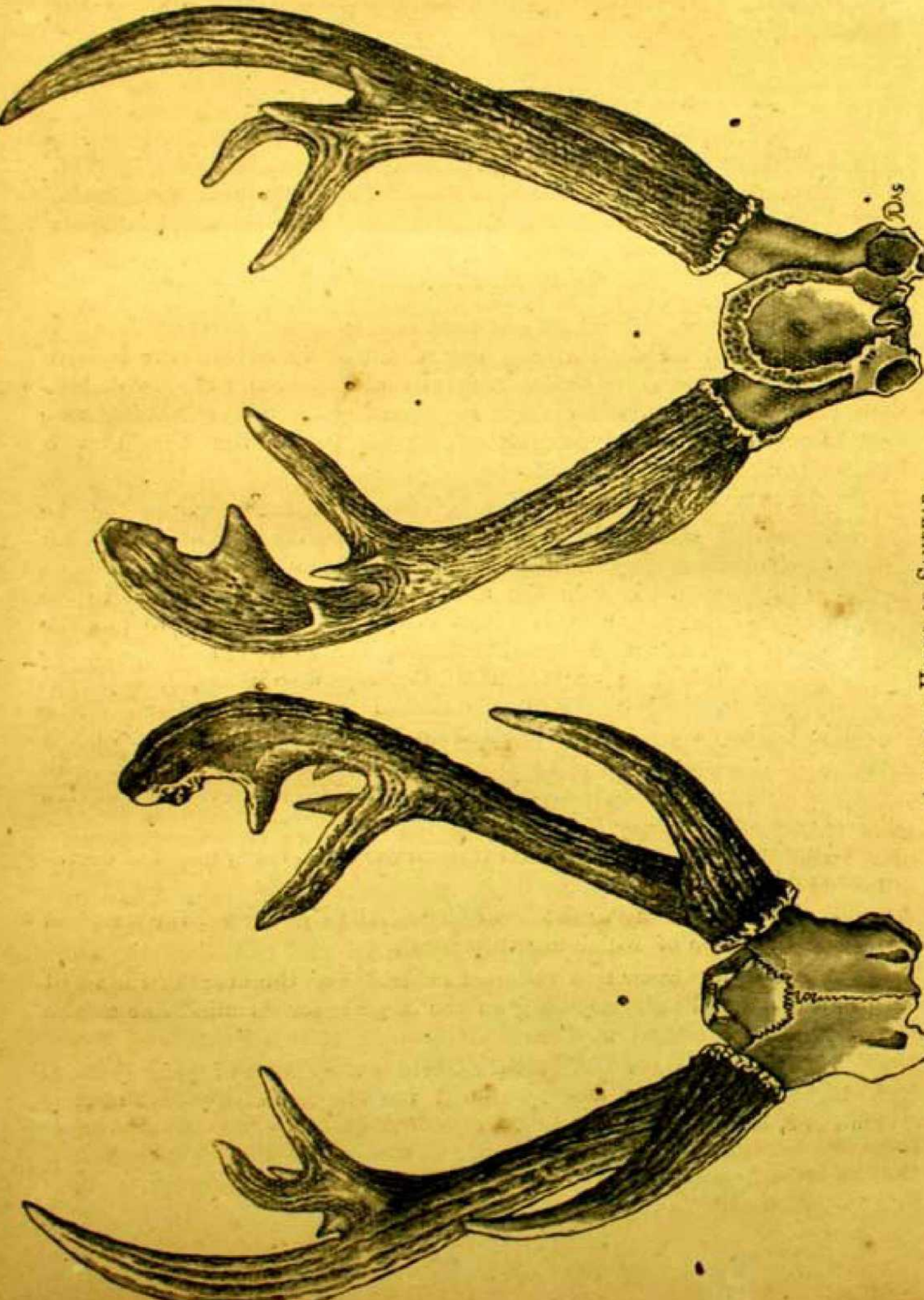
The number of points in this specimen no doubt accounts for the statement that was made to me by Mr. Ezra, that the animal which bore the horns was a hybrid between the Sambhar and the Barasingh (*Cervus duvauceli*). But in the absence of any information as to the appearance of the rest of this stag's body, I am inclined to put the specimen down as an abnormal Sambhar, some Sambhar horns in the collection exhibited in the Mammal Gallery also showing supernumerary points, though not to this extent. A very fine head in the Asiatic Society's collection, alluded to by Mr. W. L. Sclater in his pamphlet "Notes on Indian Horned Game," has nine points, both terminal tines of the right horn and the anterior or outer terminal tine of the left, being bifurcated.

Another has a third terminal tine on the right horn, directed downwards and backwards.

A third has a snag to the brow tine of the right horn, the terminal tines of the beam of which are very small.

A fourth has three small snags at the base of the beam of the right horn, and a small accessory snag on the large outer terminal tine of the left.

It is noteworthy that in all these cases the excess of points affects the right horn; but in one specimen, the single extra point, a very small one, is on the inner terminal tine of the left.



ABNORMAL HORNS OF SAMBHAR.

Mr. Ezra informs me that the present animal was killed in the Maharajah's territories six years ago.

XIV.—*Notes on Animals observed at the Alipore Zoological Garden.* No. III. *Melanic specimens of Common Palm Squirrel* (Sciurus palmarum, *Linn.*)—*By* RAI R. B. SANYÁL BAHADUR, *Superintendent, Alipore Zoological Garden.*

[Read June 4th, 1902.]

Squirrels, it is well known, are subject to great diversity in size, form and colour. The upper surface of the body of the large Indian Squirrel (*Sciurus indicus*, Erxl.) is usually of a maroon red colour, but darker, almost black individuals with thicker coats are not uncommon. Apart from their seasonal dimorphism, no two specimens of the *Sciurus bicolor* of Sparrmann are alike; and it is no wonder that the species proved a puzzle to Desmarest, Horsfield, Is. Geoff. St. Hilaire, and other naturalists of classic repute, each of whom described it under a different name. Palm Squirrels (*Sciurus palmarum*, Linn.) so common and abundant in Bengal, North-Western Provinces, the Punjab, and Central India, are also remarkable for great diversity of form and colour, and this tendency to variation in colour, which is so characteristic of the genus, has led, in the case of the Palm squirrels, to an increase in the deposition of pigment, resulting in the production of a definite melanic form.

Melanism as a common colour phenomenon is well known to naturalists, but as far as I remember, I have seen no case of complete melanism in squirrels recorded in the literature of the genus, and I have therefore ventured to exhibit to the Society a melanic specimen of a Palm squirrel which lately came under my observation. The following notes sent to me by Haji Mahammud Mustapha Khan of Aligarh, the donor of the animals, will, I hope, be found interesting:

"Some time in December last [1901], so far as I can recollect, my bearer came to me in Aligarh and said he had seen four or five black squirrels in the jungle at Burhegaon. Burhegaon is the headquarter village of my estate, in Tahsil Atrauli in this district, and lies about 25 miles east from Aligarh. I told him to try and catch them, and explained to him how best to do it by the usual basket snare. About a fortnight later, when I had gone to stay for a time at Burhegaon, he brought one of the squirrels to me. A couple of weeks after that he brought a second one. So far as I can judge they seem to be a male and a female. There was a third, he told me, which eluded capture on the second occasion. They seemed to me uncommon, and remembering to have heard, at a District Board Meeting, that the Secretary of the Zoological Gardens at Alipur would be glad of help in procuring interesting additions to his family, I mentioned the matter to Mr. Brownrigg, then Collector of the District. I have always taken an interest in animals, but had never seen any black squirrels like these before. I am told that there are still, perhaps, three or four more at large in the jungle where this pair came from, but they are now very wild, and do not allow any one to approach them. I am also informed, by those who have seen them, that these black squirrels live apart by themselves on separate trees, and do not associate with their less distinguished grey-mantled brethren. The boycott is probably mutual. I have no reason to think that they came to Burhegaon from any outside source. So far as I can see they are a freak of nature."

It would be interesting to observe other forms of animal life in the jungle in which these melanic squirrels were found, and to note whether there is any preponderance of black in them also. The fact, if proved in the affirmative, will give additional support to the theory of colour change induced by environmental causes.

This is, however, not the first time that melanic squirrels are exhibited in the Calcutta Zoological Garden. In 1877, a couple of them were obtained from Assam, and lived for about a year.

On Tidal Periodicity in the Earthquakes of Assam.—*By* R. D. OLDHAM, *Superintendent, Geological Survey of India.*

(Communicated by permission of the Director of the Geological Survey of India). [Received July 21st, Read August 6th, 1902.]

I.—INTRODUCTORY.

Ever since earthquakes were first studied there have been repeated and persistent attempts to trace the action of the sun, the moon, and the planets in producing them, or at the least in influencing their relative frequency. Mallet, from the discussion of his great earthquake catalogue[1], found that there was a marked periodicity, which caused earthquakes to have a maximum frequency towards the end of each century, with a minor, but nearly as great, maximum a little before the middle; and, more recently, Dr. A. Cancani has remarked a similar peculiarity in the earthquakes of Italy.[2] Periods of this length, however, have no direct and obvious connection with the movements of the heavenly bodies, and more interest attaches to variations of shorter periods. Perrey, and following him Mallet,[3] believed that they had detected such variations, and that the frequency of earthquakes showed a relation to the distance of the sun and the moon from the earth, and to their relative positions in the heavens, at the syzygies and quadratures. As a result of this careful investigation it had been generally accepted that earthquakes were more frequent during winter than in summer and during the night than during the day.

In 1889 the subject was again attacked by M. F. deMontessus de Ballore,[4] who started by preparing a catalogue of 15,000 earthquakes. From this he proceeded to discuss the diurnal periodicity, and found that though each individual list and record showed a distinct periodicity, there was no agreement among them and that the larger the number of shocks taken the more uniform became the resulting distribution of earthquakes throughout the day and night. In a subsequent paper[5] he applied the same treatment to the seasonal periodicity with a similar result and came to the conclusion that there was no real variation in the frequency of earthquakes, which he regarded as a purely geological phenomenon, unaffected by either astronomical or meteorological influences.

About the same time Dr. Davison began his investigation of earthquake frequency, and in a laborious paper,[1] on the annual and semi-annual periodicity of earthquakes, came to the conclusion that, treating each region separately, there was a distinct variation in frequency, which was in excess of that which might be expected if the occurrence of earthquakes was in no way connected with the seasons.

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[1] Rep. Brit. Ass., xxviiii, (1858).

[2] Boll. Soc. Sismol. Ital. vii, 205-209 (1901).

[3] Brit. Ass. Rep., xxviii, (1858).

[4] Archives des Sciences Physiques et Naturelles, 3. Ser., xxii, 409, (1889).

[5] Archives des Sciences Physiques et Naturelles, 3. Ser., xxv, 504, (1891).

From this brief review it will be seen that the question, of whether earthquakes are at all affected by extra-terrestrial influences, is at present an open one, and for this reason I made every effort, after the great earthquake of 1897, to obtain the fullest possible record of the extremely numerous after-shocks, thinking that if there was any external cause at work it should be especially easy to trace at a time when, and in a region where, the earth's crust was evidently in an extremely unstable condition. The discussion of these records is not complete but in the case of one of them it has been completed, so far as one particular phase of the frequency is concerned, and the results obtained appear to be of sufficient interest to justify some notice of them.

In July of 1897, Mr. T. D. LaTouche, who was then in Shillong reporting on the results of the earthquake, constructed a seismograph on the duplex pendulum system, which was set up by the Executive Engineer, and from which continuous records have been taken ever since. The instrument, like all seismographs, is far from a perfect one, it does not record many shocks which can be distinctly felt, and it does not record the time, yet the records are of great value. In the first place we know that every shock recorded attained a certain standard of range of motion of the wave particle and of violence, if such a word may be applied to what in many cases are merely slight shocks, and that all the shocks exceeding this standard are recorded. The absence of automatic time record is more serious, but as the time of the shock was, in every case, recorded by the observer we may take it that there is no very serious error or omission in this respect. Every shock recorded represents one at approximately the time given, and the only cause likely to affect the periodicity is a possible error in the case of the night shocks: it is possible that the instrument may at times have registered a shock while the observer was asleep, and the record afterwards referred to one, felt when he was awake, which did not affect the instrument. The uncertainty due to this cause is, however, slight, as the gentlest shock registered by the instrument is sufficiently strong to usually awake a sleeper.

From this instrument we have received records from August 1897, but those discussed as yet only extend to the end of 1901; so far they have only been examined with a view to the hourly variation in frequency, and instead of contenting myself with a mere record of the relative frequency of the earthquakes, as has usually been done in the past, I have made an attempt to see whether there is any trace of extra-terrestrial influence in this frequency.

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[1] Phil. Trans. clxxxiv, A, 1107 (1893).

As pointed out by me in a short note published in 1901[1] any effect which the attraction of the sun and the moon may have, will be most effectively, if not solely, exerted by the Tide-producing forces they set up, and that, to trace the effect of these, it is not sufficient to merely tabulate earthquakes by the hours in which they occur. The time at which the tide-producing forces reach their maximum depends on the declination of the sun and the moon, that is to say it is subject to seasonal variations, and to determine whether these forces have any influence it is necessary to classify the records, according to the position of the sun or moon with reference to the equator, and then examine the frequency to see whether there is any variation which can be correlated with the tidal forces.

II.—STATEMENT OF THE PROBLEM.

There is neither space nor occasion to recapitulate what is known of the theory of the tides, but a brief account of the form of the tide-producing influence of the attraction of the sun and the moon is desirable, that the nature of the effect to be looked for may be clearly understood, and the review will be simplified by the fact that we need not consider the theory of the tides themselves, but merely of the stresses to which they owe their origin. Omitting all reference to the why, it will be sufficient to point out that the effect of the attraction of a satellite—and in this connection the sun is regarded as a satellite equally with the moon—is to produce a stress equivalent to an upward force at the spot which is at any moment directly under the satellite, and at the antipodes of that spot. Along the great circle half way between these two spots, separated from each by 90° of arc, there is a force acting downwards towards the centre of the earth, and equal in amount to one half of the upward force. At spots between these two points and the great circle just referred to, the stresses produced are equivalent to forces acting in directions away from the vertical, and along a circle which is distant about 54° 44′ 14″ from the spots where the satellite is in the zenith or nadir the force acts horizontally.

Now if we suppose the force exerted at any point to be resolved into two separate forces, one acting vertically and the other horizontally, then the vertical force attains its upward maximum where the satellite is in the zenith or nadir, and its downward maximum along the great circle intersecting the line joining these two points and lying at right angles to it. The horizontal force attains its maximum along two circles distant about 54° 44′ from the zenith and nadir respectively, the direction being towards the satellite in the former case and away from it in the latter. If then the tidal stresses have any influence in determining the time of origin of earthquakes we should look for the effect in connection with these circles.

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[1] Geol. Mag. 4. Decade, viii, 449, (1901).

Both sun and moon, as is well known, vary their position in the heavens, travelling alternately north and south of the equator, the sun moving to about 23°, and the moon to about 26°, from it. From this it follows that neither can ever be in the zenith of any spot distant more than 26° from the earth's equator, that is in more than 26° of latitude either north or south, and no spot situated outside those limits can ever experience the maximum upward force. Within those limits, at either one or two periods in each year, when the declination of the sun and the latitude of any given place are the same in amount and sign, the maximum upward force, due to the sun, will be experienced at midday and midnight; and similarly in each lunar month there will be either one or two periods at which the maximum upward force will be experienced, when the moon is either overhead, mid-moon-day, or underfoot, mid-moon-night. Outside the limits of the two 26° parallels, and within them at all times when the declination of the sun or moon is different in amount or sign from the latitude, the maximum upward force will not be experienced, but, as the earth revolves on its axis, the circles of maximum horizontal and downward force sweep over its surface, and pass any given place at an interval, before and after the meridian passage of the satellite, which depends on the declination of the satellite at the time and the latitude of the place.

From these considerations it will be seen that, before discussing the frequency of earthquakes with reference to the tidal stresses, it is necessary to group them according to their place of origin, and then see whether, for any one district, there is a connection between the relative frequency of earthquakes and the times of passage, over the epicentre, of the circles of maximum tidal force.

One method of discovering whether there is any such connection would be to calculate for each earthquake the exact time which separated the time of its origin from that of the passage of each of the circles of maximum tidal force, and then to classify the records according to these intervals, and see whether there was any preponderance of earthquakes at or about these times. The process would be a laborious one, and, in view of the want of exact accuracy in the times, did not seem worth going through, as a result within the limits of accuracy of the records can be obtained in a simpler manner.

We may assume that the epicentres of the earthquakes now under consideration all lie in 26° N. Lat., without introducing any material error, and, calculating for that latitude the time intervals, which elapse between the meridian passage of the satellite and the passage of the tidal circles, we obtain, for extreme and mean values of declination the intervals given in the tabular statement below,[1] where 0 h represents the lower, and 12 h. the upper, meridian passage, or midnight and midday in the case of the sun.

I.—*Table showing the times of passage of circles of maximum horizontal and vertical Tide-producing force ; calculated for Lat. 26° N.*

Decl.	Hor. force, Direct.	Vert. force, Downward.	Hor. force, Indirect.
	12 h. ±	0 h. ±	0 h. ±
	h. m.	h. m.	h. m.
26° N.	4-15	4-38	——
9° N.	3-31	5-34	2-14
0°	2-59	6-0	2-59
9° S.	2-14	6-26	3-31
26° S.	——	7-22	4-15

From this table it is obvious that, if the total number of shocks is divided into three groups, according to the position of the sun, the first comprising those which occurred when the sun was more than 9° N., the second when its declination did not exceed 9° N. or S. and the third when the declination was more than 9° S., then in the first group the effect of the horizontal force must be looked for between 3½ and 4 hours before and after midday, and within two hours on each side of midnight; in the second group the effect is to be looked for between 3 and 3½ hours on either side of midnight and midday; while in the third the condition will be the same as in the first, with the substitution of midnight and midday. Moreover, as the effect may be due rather to the rapidity of changes in the amount, than to the actual amount, of the force exerted, the horizontal force may have but small influence when the passage of the circles takes place at less than two hours on either side of the meridian passage, that is to say, when the intersection of the circles is oblique, and the rate and range of change in the amount of force is less than when the passage takes place at a greater time-interval than 2 hours from the meridian passage. This, combined with the much greater length of time during which the interval exceeds three hours, shows that in a general list of all the shocks the effect must be looked for between 3 and 4 hours on either side of midday and midnight. Further, as it is a common phenomenon in nature that the maximum of effect lags behind the maximum of cause, it may be that the effect will not be found between 3 and 4 hours on either side of the meridian passages, but at some time after that epoch. Another effect which may be looked for, which follows from the consideration of the greater efficiency of the force when its rate of variation is greater, is that we may expect the number of shocks recorded during the day to be proportionately greater when the sun is more than 9° N., that is during the summer, and the night shocks to be proportionately more numerous during the winter, when the sun is more than 9° South of the equator.

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[1] The intervals are not exactly the same on either side of the meridian passage on account of the motion of the sun and moon in the heavens, but the inequality is not sufficient to be of importance in this connection.

There is another supposition which must also be tested, that the effect, if any, of the tidal forces is not to be looked for in connection with the times when they attain their maximum, but with the times at which the rate of change, of amount and direction of the forces, is at its maximum. For any particular place the rate of change always reaches its maximum at 3 hours before and after the meridian passage, but along a great circle, passing through the place of observation and the place where the satellite is in the zenith, the maximum rate of change is at 45° from the latter, and it will be useful to see what is the time interval for different declinations at which a circle 45° distant from this spot passes the place of observation. The result is given in the following table.

II.—*Times of passage of circles of maximum rate of change of the Tide-producing forces calculated for Lat. 26° N.*

Decl.	Direct.	Indirect.
	12h ± h. m.	0 h ± h. m.
26°N.	3-22	——
9°N.	2-56	1-56
0°	2-33	2-33
9°S.	1-56	2-56
26°S.	——	3-22

It must be distinctly understood that the times given in this table are not those at which the rate of change is actually greatest, but those at which the rate is greatest, as measured along a different circle to the east and west one, along which the place of observation travels. In the solitary case where this place and the satellite are both on the equator the two agree, and in no other; but the table is useful, for the closer the value in the table approximates to 3 hours the greater is that rate of change, and the closer it lies to 0 h. or 12 h. the less is the rate of variation of the tide-producing forces.

The passage of the circles of maximum vertical force is not subject to the same changes as that of the other circles, and never varies more than 1 h. 22 m. from six o'clock; the effect of this force must therefore be looked for about that time in the morning and evening or somewhat later.

Finally, it is necessary to notice one objection, which might be raised to the preceding passages, that the effect is not necessarily to be looked for at any fixed time before or after the meridian passage of the satellite, but that, for each place, there will be something equivalent to what is known as the "establishment" of a port in the case of marine tides. The objection, however, is not valid, for in this case we have not to do with free travelling waves, like that of the tides, which take a greater or less time to travel from the place where they originate to the place where they are felt, but with the direct effect of the stresses which produce the waves. These depend solely on the latitude of the place and the declination of the satellite, and for them there is nothing in any way analagous to the "establishment" to be considered.

III. DISCUSSION OF THE DATA.

After this preliminary exposition of what is to be looked for, we may pass on to a consideration of the results obtained. In the record discussed there are contained 1274 distinct shocks, and, on counting these it was found that, in each hour of the twenty-four, the number of shocks recorded was as given in the tabular statement No. III, where all shocks recorded from 0 h. to 0 h. 59 m. are placed under 0, those between 1 h. and 1 h. 59 m. under 1 and so on.

The most casual inspection of this table shows that the shocks are not at all uniformly distributed during the twenty-four hours, and that there is a great preponderance during the hours preceding midnight, with a lesser increase towards 6 A.M. It may also be noted that the night shocks seem more numerous when the sun is more that 9° S and the day shocks when it is more than 9° N, but no proper comparison is possible on account of the difference in the total number of shocks in each line. For comparison they must be brought all to the same ratio, and this may be done, either by calculating the percentage of the total number of shocks recorded in each hour, or more simply by dividing each figure by the mean value for the line; this gives a result showing the proportion of the number of shocks recorded in each hour to the average number for one hour. In this way we get the result shown in the next tabular statement.

III.—*Hourly distribution of Shocks.*

Sun's Declination / Hours	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL.
>9°N ...	11	15	16	12	13	24	24	8	22	12	22	21	16	13	22	12	27	16	14	17	21	30	28	20	436
9°N–9°S ...	5	8	14	14	26	14	16	16	9	15	13	14	11	18	9	22	22	11	12	13	19	17	21	19	358
>9°S ...	17	21	29	29	22	19	30	16	10	15	8	19	16	12	17	13	22	19	22	20	20	24	41	19	480
TOTAL ...	33	44	59	55	61	57	70	40	41	42	43	54	43	43	48	47	71	46	48	50	60	71	90	58	1274

IV.—*Proportionate distribution of Shocks by hours.*

Sun's Declination / Hours	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
> 9°N ...	·61	·83	·88	·66	·71	1·32	1·32	·44	1·21	·66	1·21	1·16	·88	·72	1·21	·66	1·49	·88	·77	·93	1·16	1·65	1·54	1·10	
9°N-9S ...	·33	·54	·94	·94	1·74	·94	1·07	1·07	·60	1·01	·87	·94	·74	1·21	·60	1·47	1·47	·74	·81	·87	1·27	1·14	1·41	1·27	
>9°S ...	·85	1·05	1·45	1·45	1·10	·95	1·50	·80	·50	·75	·40	·95	·80	·60	·85	·65	1·10	·95	1·10	1·00	1·00	1·20	2·05	·95	
All shocks ...	·60	·80	1·09	1·02	1·19	1·07	1·30	·77	·77	·80	·83	1·02	·80	·84	·89	·93	1·35	·86	·89	·94	1·14	1·32	1·67	11·1	

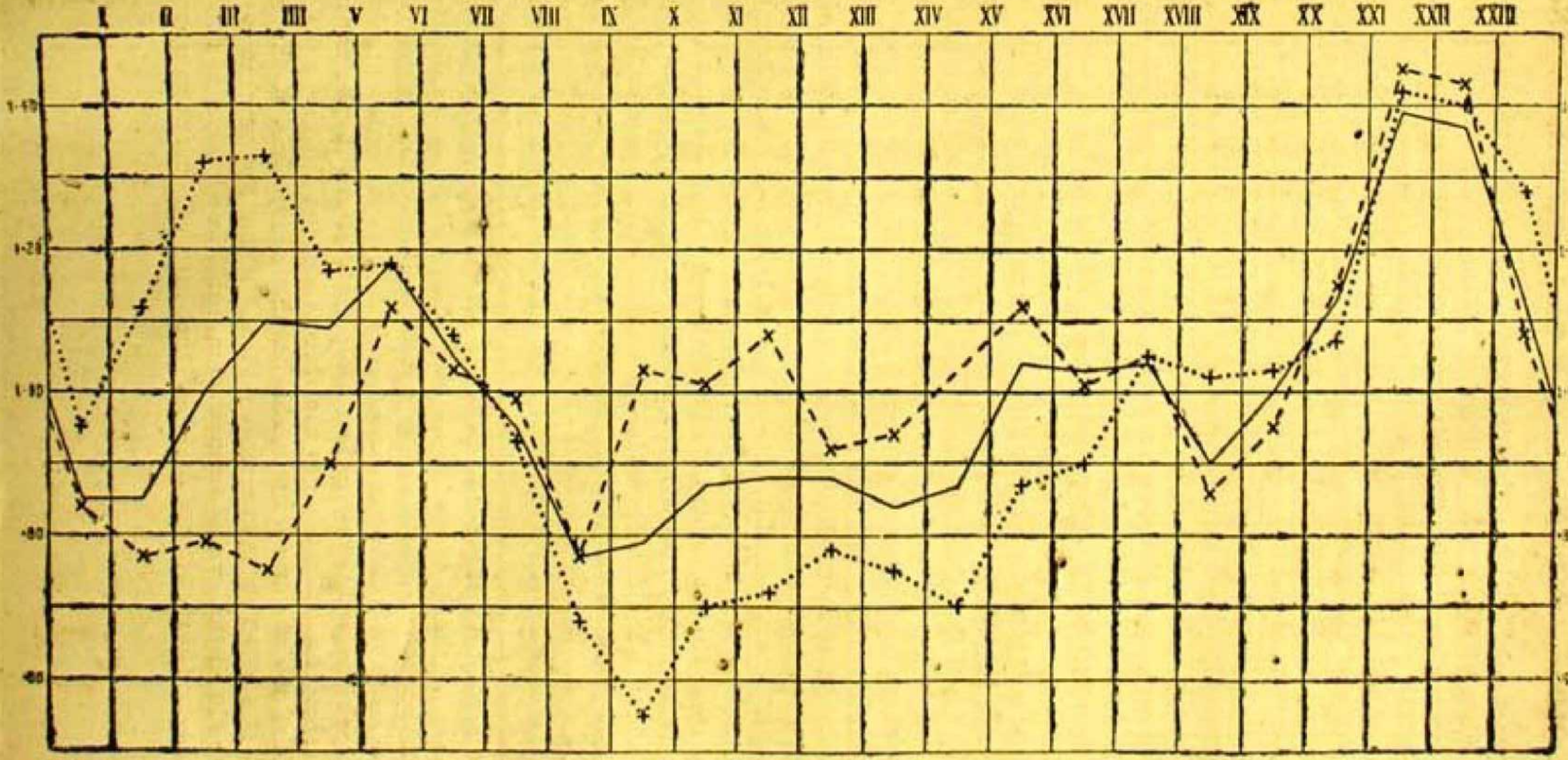

Shillong Seismograph 1897-1901. Hourly curve of frequency smoothed by means of 3 hours.

Fig. 1. Curves of diurnal distribution of earthquakes. The continuous line is the general curve obtained from all shocks. The broken line represents the distribution of shocks occurring when the sun's declination was more than 9°N. The dotted line is the curve for shocks occurring when the declination as more than 9°S.

Here we again see that the day shocks are proportionately more numerous when the sun has declination of more than 9°N. than when the sun is more than 9°S. of the equator, and that in the latter case the night shocks are proportionately more numerous than in the former. It is also evident, from the irregularity of distribution from hour to hour, that the number of shocks is not enough to give a near approach to the true curve, when plotted directly, and a process of smoothing has to be adopted. This has been done by adding together the number of shocks recorded during each group of three successive hours and, by regarding them as grouped round the centre of the middle hour, obtaining a fresh series of hourly means, from which a great deal of the irregularity of the curve has disappeared. The result is represented graphically in Fig. 1, so far as the shocks which occurred when the sun was more than 9° north and south of the equator respectively.

From this curve it will be seen that as regards the shocks occurring about two hours before midnight there is little difference, but that for the rest of the twenty-four hours the curve for south declination is steadily above that for north declination throughout the twelve hours of the night, and below it for the day. Moreover there is a distinct maximum in the earthquakes recorded round three hours after and two hours before midnight, while the earthquakes recorded near midnight are much more frequent than when the sun was more than 9° north of the equator. Turning to the shocks recorded when the sun was north of the equator, not only are they proportionately more numerous, than when it was south but there is again a distinct pair of maxima, shortly before and three hours after midday. Among the shocks recorded when the sun was within 9° of the equator we have maxima distinctly marked at about 5 hours after midnight and midday, another at about 2 hours before midnight and a less marked one at about 2 hours before midday.

There is consequently an approach to what might be expected if the tide-producing forces caused by the attraction of the sun had their effect in determining the time of origin of earthquakes, but it is also evident that, if these forces have any effect, it is so small and so complicated by other causes, giving rise to a greater variation in frequency than they do, that it is necessary to adopt some method of discussion, which will more or less completely eliminate the effects of variation, other than those due to the tide-producing forces.

The most obvious of these would be the conversion of the solar into lunar times. The moon moves through the heavens at a rate which brings it on the average about 50 minutes in advance of the sun for each day. If, then, we consider the interval between the two successive similar meridian passages of the moon as representing 24 lunar hours, and convert the recorded times into lunar times, it is obvious that, in a long series of observations, any irregularity of frequency, at any particular hour of solar time, will get spread over the whole of the lunar day, and in its place will be introduced any fresh irregularity due to the position of the moon. Now as the moon has twice the efficiency of the sun, as a tide producer, any irregularities due to the tide producing forces should be double as great as in the case of the sun.

Unfortunately the test cannot be applied in this case as, on trial, it was found that the series of observations was not sufficiently long to eliminate the effect of the diurnal irregularities.

This method of elimination failing, we must fall back on the recorded times, to see whether there is no other method of eliminating the non-tidal diurnal variation, and a method appears which depends on the fact that, taking the year as a whole, the tidal effect is on the average the same all through, since the times of passage of the tidal circles during the six hours on either side of midnight are the same for a south declination as the times on either side of midday in the case of the same amount of north declination.

If, then, we take the recorded frequency of shocks for each hour, write them down in two lines, placing those for the hour after midday under those for the hour after midnight and so on, and then add the two lines, we obtain a series of numbers representing the semi-diurnal curve of frequency. In this curve any diurnal periodicity, which is of a harmonic nature, is completely eliminated, and any non-harmonic periodicity largely reduced in amount. On the other hand any semi-diurnal periodicity which is harmonic in character, or which, if not harmonic, has its irregularities similarly distributed with regard to midnight and midday, will be exaggerated; that is to say the effect we are looking for will be increased, while that which we wish to eliminate will be reduced, in amount.

In the next tabular statement the process is illustrated as regards the total number of shocks, and four more lines given, showing the results obtained in the case of certain combinations of shocks, which will be referred to further on.

V.—*Semidiurnal distribution of Shocks.*

Hours.	0 12	1 13	2 14	3 15	4 16	5 17	6 18	7 19	8 20	9 21	10 22	11 23
All shocks 0 h. to 11 h.	33	44	59	55	61	57	70	40	41	42	43	54
Do. 12 h. to 23 h.	43	43	48	47	71	46	48	50	60	71	90	58
Sum	76	87	107	102	132	103	118	90	101	113	133	112
Sum ÷ Mean	·72	·81	1·01	·96	1·26	·97	1·11	·85	·95	1·06	1·25	1·05
Day shocks > 9° N. Night shocks > 9° S.	80	·82	1·23	·99	1·18	·84	1·11	·67	1·01	·87	1·52	96.
All shocks 9° N. to 9° S.	·53	·87	·77	1·20	1·61	·84	·94	·97	·94	1·08	1·14	1·11
Day shocks > 9° N. All shocks 9° N. 9° S. Night shocks > 9° S.	·69	·84	1·04	1·08	1·36	·84	1·04	·80	·98	·95	1·36	1·02
Night shocks > 9° N. Day shocks > 9° S.	·77	·77	·94	·71	1·00	1·23	1·26	·94	·94	1·29	1·03	1·12

Here we see two very marked maxima, in the distribution of the shocks, one during the fifth hour after, the other during the second hour before, the meridian passage, and these maxima may be taken as grouped around 4½ hours and 10½ hours of the morning and afternoon. That is to say they both follow by 1½ hours the epoch corresponding to three hours before and after the meridian passage, a time which corresponds more closely to the passage of the maximum rate of change of tidal force, than to that of the circle of maximum horizontal stress.

If we turn to the next line in the table, representing the distribution when the tide producing forces may be expected to be most effective, we find the same features, except that the maximum following the meridian passage is less marked than that which precedes it, and that though the latter is proportionately greater than in the case of the whole number of shocks the former is less.

The next line shows the distribution when the sun is within 9° of the Equator, when on the average the conditions—so far as the tide generating forces are concerned—are the same during the day as the night. Here we find the two maxima again, but it is that following the meridian passage which is most conspicuous, the other being small and ill defined.

The fact is that in both these cases the total number of shocks considered is too small to get an approach to a true average, and, in this small number of shocks, accidental variations of distribution may produce an irregularity of the curve which exceeds its normal variation.

To some extent this difficulty may be overcome. If we refer to the tables I and II, we will see that when the sun is within 9° of the equator, there is not a very great variation in the times of passage of the tidal circles as compared with the times of passage during the day when the sun is north, and during the night when it is south, of the equator. On the other hand the night when the sun is north, and the day when the sun is south, of the equator, show a much greater range of time in the passage of the circles and not only is the range of time greater and the effect consequently less conspicuous, but during part of the time the maximum of horizontal force is not felt at all, and during the rest of the time the passage is so oblique that the rate of change is slow and the tidal forces probably less effective.

Excluding these shocks we may add together the two groups of shocks already considered and so obtain a larger one, in which the tidal effect is tolerably uniform. The result is given in the table, and shown graphically in Fig. 2. Here it will be seen that the two maxima preceding and following the meridian passage are both distinct, and exceed those obtained from the total number of shocks.

Shillong Seismograph 1897-1901. Semidiurnal curve of frequency.

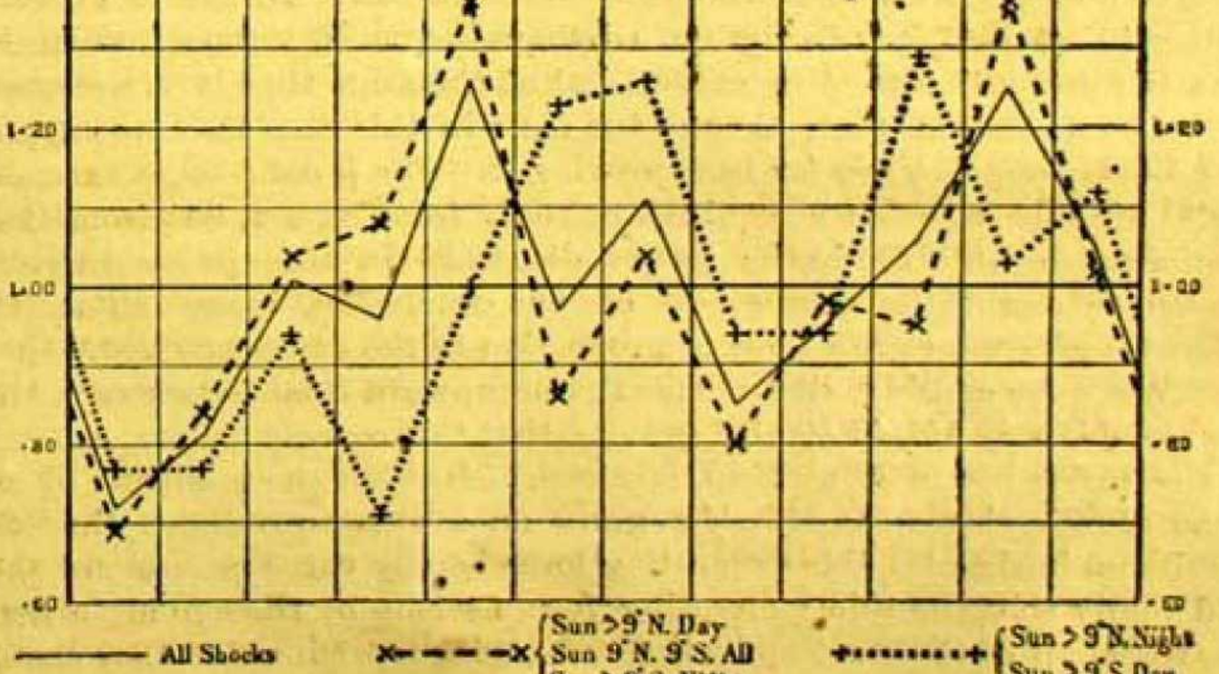


Fig. 2. Semidiurnal curves of frequency.

We have consequently the effect which was to be looked for if the frequency of earthquakes is influenced, either by the amount of the horizontal tide generating force, or by the rate of change of the tide generating forces, and the fact that this effect becomes more marked the larger the number of shocks—suitably distributed as regards time of occurrence—which are taken into consideration, lends support to the supposition that the apparent relation between cause and effect is a real one.

Passing on to the last line, representing the night shocks when the declination is north and the day shocks when it is south, that is to say a time when the rate of variation of the tidal stresses is at its lowest and less effect to be looked for, we find that the marked maxima have disappeared, and that there is an almost equally distinct increase in frequency about six o'clock, that is at a time corresponding to the passage of the circles of maximum vertical force. This has the appearance of indicating that the purely vertical stresses have less influence than those which have a large element of horizontal stress, and that the effect of the former only becomes apparent when that of the latter becomes small. Too much stress must not, however, be attached to this conjecture, as the number of shocks dealt with is smaller than in any of the other combinations, and the possibility of fortuitous irregularities in the curve more probable in a corresponding degree, and besides this the effect here only lags half an hour behind the presumed cause, while in the case of the $4\frac{1}{2}$ and $10\frac{1}{2}$ hour maxima it lags $1\frac{1}{2}$ hours behind the presumed cause.

It appears then that the tidal stresses have a distinct effect in determining the time of origin of earthquakes, though their influence is small in proportion to other causes, but at the same time it is necessary to enter a caution that, though the facts in this case seem to support the conclusion, they are far from proving it. For proof a more extended series of observations are required, not only from Assam, but from other stations also, and even in the record discussed in this paper there is reason to doubt the correctness of the conclusion, inasmuch as the effect found appears to be out of proportion to the cause invoked.

When we consider that the maximum upward tidal force exerted by the moon is only 1/8, 450,000 of gravity, that this corresponds very closely to the difference in downward strain which would be produced by the removal or replacement of half a grain on a one-ton weight, that the maximum horizontal tide generating force is only three quarters of this, and finally that the tide generating forces set up by the sun are a little less than half of those set up by the moon, it is surprising that they should have any effect at all. On the other hand when we consider that these forces are sufficient to give rise to the tides, and that the difference between the spring tides and the neaps is due to the forces whose effect has been searched for in this paper, it is quite conceivable that they should not be without effect in determining the moment at which a gradually increasing strain becomes too great for the resistance, and the fracture is produced which gives rise to an earthquake.

IV.—Conclusions.

From what has gone before we may draw the following conclusions.

1. That there was a very large variation in the diurnal distribution of earthquakes in Assam during the years 1897-1901, shocks being most frequent between 10 and 11 P.M., and again between 6 and 7 A.M. This greater frequency is a real one and not merely due to a larger number of shocks happening to be recorded at those times.

No satisfactory cause can be assigned for this irregularity of distribution, which must for the present be accepted as a fact true for a limited period and area.

2. Superimposed on this large and unexplained variation in frequency, there is a smaller variation which has the appearance of being due to the tidal stresses set up by the attraction of the sun.

3. If this smaller variation is really due to tidal stress, then the horizontal stress is much more efficient than the vertical stress, and the effect is less due to the amount of the stress than to the rate and range of its variation.

4. That these conclusions must be taken as purely provisional and require verification from a more extended series of observations. For their verification we require an instrumental record from some station within or near the tropics, where earthquakes are fairly frequent, and extending over 19 or 20 years.

XVI.—*General Notes on Variation in Birds.*—*By* F. Finn, B.A., F.Z.S., *Deputy Superintendent of the Indian Museum.*

A. Some Striking Cases of Variation in Structural Characters.

I have occasionally been able to note marked deviations instructure, which might conceivably have been useful in some cases.

Thus I saw at a Pigeon show in Oxford, on October 23rd, 1891, a white Fantail Pigeon with the two inner front toes on each foot webbed. The abnormality is not common, but has been recorded by Darwin. (*Animals and Plants under Domestication*; Vol. I. *p.*, 160).

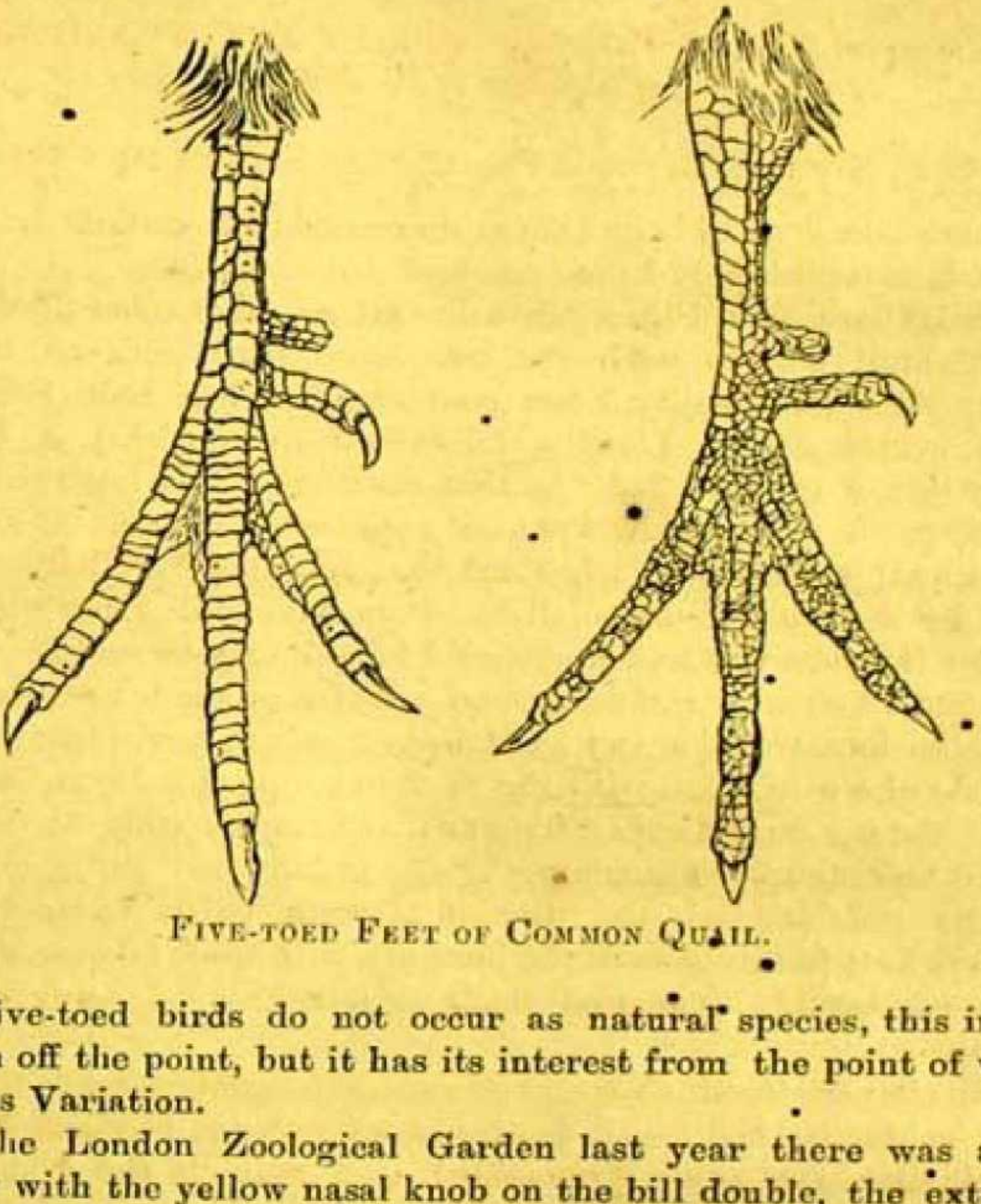
I obtained in Port Said in 1894 the feet of a common fowl with a long hallux like a Curassow's but not apparently capable of flexion at the terminal joint, being more like the supernumerary hallux so often present in these birds—especially in Port Said specimens, where every gradation between this and the normal hallux may be seen.

In Zanzibar, where the fowls are usually of the long-legged Malay type, I occasionally saw a very short-legged specimen with the usual long neck. As there are some breeds of fowls, *e.g.*, the Japanese Bantam, wherein the legs are always very short, this is probably an easily perpetuated and abrupt variation.

At a meeting of the British Ornithologists' Club last year, Mr. W. B. Tegetmeier showed the head of a wild Rook (*Corvus frugilegus*) with a remarkably elongated beak approaching in form that of a Chough.

The Chough itself (*Graculus graculus*) in confinement is liable to an elongation of the bill which is often very regular, and makes the beak resemble that of an Ibis. This might well occur in the wild state—as overgrowth of the upper chap is known to do in some birds—and be of service. The subjacent tissues may also penetrate the overgrowth of horn, for Mr. Rutledge found on attempting to cut back the overgrown bills of some Choughs that this could not be done, as blood was drawn in cutting off the first half inch.

Recently I procured in the Calcutta Bazaar a common Quail (*Coturnix communis*), possessing on each foot five toes like a Dorking fowl. In each case, as so often happens in five-toed fowls, the true hallux was higher up the shank than usual. The upper supernumerary hallux was quite distinct, but shorter than the normal one, whereas in five-toed *fowls* it is usually longer. One only of these extra toes had a claw, but as it was loose on the other, and ultimately came off, it had evidently become accidentally detached from one toe. An enlarged drawing of these feet is given below.



FIVE-TOED FEET OF COMMON QUAIL.

As five-toed birds do not occur as natural species, this instance may seem off the point, but it has its interest from the point of view of Analogous Variation.

In the London Zoological Garden last year there was a male Curassow with the yellow nasal knob on the bill double, the extra part being somewhat out of line with the normal lump, and extending behind it.

B. SOME COLOUR-VARIATIONS IN WILD BIRDS.

The Garganey or Blue-winged Teal (*Querquedula circia*) is very liable to produce a pallid variation, in which the usual brown markings are reproduced in a pale dun shade. These pale forms vary in pallor, but do not grade into the normal type. Males and females are about equally affected. The irides of such birds are normal, but their bills and feet are flesh-coloured instead of slaty. A white Garganey I once saw as a skin seemed, however to have had dark bill and feet. Mr. E. C. S. Baker records (*J.B.N.H.S.*, Vol. XII., *p.* 446), a Garganey with orange feet, with, I presume (as he says nothing to the contrary) normal plumage. After examining hundreds of both this species and the Common Teal (*Nettium crecca*), I have never seen any variation in the latter.

Snipe (*Gallinago cœlestis* and *G. stenura*) frequently present pallid forms, which, as in the Garganey, vary *inter se* but do not grade into the type. I was fortunate last winter in procuring, in addition to a pallid specimen of the Fantailed species, a Pintail Snipe, which was a pied bird of remarkable aspect. The general plumage was normal, but the dark-streaked buff plumage of the fore-neck and breast was interrupted by a longitudinal white patch, and there was a great deal of white in both wings. The right wing had the first three primaries white, together with nearly all the wing-coverts of the outer part of the wing, forming a conspicuous patch. On the left wing all the primaries were white, and a still greater extent of the wing-coverts. The irides, bill and feet were normal, except that the toes were fleshy orange instead of olive-green like the shanks. (Ind. Mus. Reg. 24155, ♂.)

I have thought it worthwhile to have this specimen figured (Plate VIII, fig. A), together with two pallid specimens of this species (*G. stenura*) (Plate VIII, figs. B, C) of different shades.

Pallid forms of the Indian House-Crow (*Corvus splendens*) are not rare; one of a pale fawn, with the face and wings darker, lived 15 years in the Calcutta Zoological Garden; this had fleshy white bill and feet. Some rather similar specimens in the Indian Museum have, however, evidently had dark bills and feet. The white specimens we have have had fleshy white bills and feet, and this has been the case with all the white Jackdaws (*Corvus monedula*) I have seen in England; about half-a-dozen in all. (I believe, however, these white Jackdaws are a domesticated race).

I have thrice in seven years secured pallid varieties of the Rain-Quail (*Coturnix coromandelica*), once only of the common Quail (*C. communis*), though this is more abundant in the Calcutta Market. These birds have always been hens. I have now got another hen Rain-Quail with all the primaries and their coverts, with the two outer feathers of bastard-wing, pure white in the left wing; on the right side, all the primaries but the fourth, ninth and tenth, with the distal primary coverts, were white, but bastard-wing normal. The centre of the throat and a patch on the fore-neck, were also white. (Reg. No. 24229). The irides, bill, and feet were normal.

Grey or slate-coloured varieties are not common, but I have seen two such in the Jackdaw (*Corvus monedula*), one in the King-crow or Black Drongo (*Dicrurus ater*) and one in the Bengal Bulbul (*Molpastes bengalensis*). In the last-named bird the red under-tail-coverts persisted.

Recently Mr. Rutledge obtained a pale ash-coloured House-crow (*Corvus splendens*), a young bird, with dark-lead-coloured bill and feet, and wings and tail faintly barred with darker grey than the ground-colour.

White varieties are so well known as to need little comment; they are seldom pink-eyed like albino mammals. Red often persists in such; I have seen an albino red-whiskered Bulbul (*Otocompsa emeria*) retaining the red "whiskers" and under-tail-coverts, and an albino Goldfinch (*Carduelis carduelis*) retaining the red face and yellow wing-bars.

In India I have seen two pale varieties of the crimson-breasted Barbet or Coppersmith (*Xantholæma hæmatocephala*), one in the Indian Museum, and one now alive at the Alipore Zoological Garden. In the former (Reg. No. B5031) the plumage is yellowish white except the primary-coverts and several quills from the sixth onwards, which are normal. The stiff glossy frontal feathers and breast patch are pale yellow instead of scarlet. The beak is yellowish white in the skin. In the latter, captured adult, the red of forehead, breast, and feet persists. The bill is flesh-coloured instead of black. The plumage is pale yellow, irregularly marked with green. It has not changed in moulting.

The common Ring-Parroquet (*Palæornis torquatus*) frequently produces a yellow variety, in which the red bill in both sexes and red collar of the male persists. I have also seen, besides numerous green birds splashed with yellow, a bird of an even intermediate tint between yellow and green. Specimens shaded with green on a yellow ground are not uncommon. Mr. W. Rutledge knows of a case where two normally coloured wild birds constantly produced a yellow brood.

The large Ring-Parroquet and its races (*Palæornis nepalensis, &c.*), is very rarely lutinistic; we have, however, in the Indian Museum a green-tinted lutino of the large-billed Andaman race still showing the red wing-patch. (Reg. No. 22071).

The Rose-headed Parroquet (*P. cyanocephala*) is not infrequently yellow, when the head is pink (as in specimen 23981, Ind. Mus. Reg.).

In the Indian Museum there is a specimen of the Blue-crowned Hanging Parroquet (*Loriculus galgulus*) with primaries nearly all yellow and many other yellow feathers. The bill is black as in the normal birds, but the blue patch on the head is replaced by a faint red one. (Reg. No. B. 342).

I once, in England, saw a wild Song-Thrush (*Turdus musicus*) with the tip of the tail regularly white; but it had an abnormal-looking patch of white on one wing also.

The Calcutta Zoological Garden once possessed a Coucal or Crow-Pheasant (*Centropus sinensis*) with bill and feet normally black, normal red irides and chestnut wings, and all the rest of the plumage white, where it should have been black. In the Museum is a pale dun bird of this species with pale chestnut wings, and the two central tail feathers decidedly fibrous and loose in texture. (Reg. No. B. 7220 procured in Purneah 1871). Mr. Rutledge recently had a dun-coloured male Koël (*Eudynamis honorata*) with fleshy-white bill and feet, but normal eyes. Its plumage faded before moulting, to cream-colour, like a dun pigeon's, the new feathers being strikingly darker.

I have discussed the question of the white-headed form of the Ruff (*Pavoncella pugnax leucoprora*) in *J.A.S.B., Pt. II*, 1902, *p.* 82. Both the living Ruffs mentioned there assumed pure white ruffs and ear-tufts this year; but one had a rufous-marked back, and the other—with the white tertiaries—a grizzled one.

C. REVERSION TO NORMAL COLOUR IN ABNORMAL VARIETIES.

A much-prized albino or lutino specimen, taken in that condition, often disappoints its owner by moulting out into the normal colour. Mr. W. Rutledge tells me that this is always liable to happen unless the individual has pink eyes or an abnormally white bill or feet. I have seen entire or partial resumption of the normal colour in two House-Mynahs (*Acridotheres tristis*), and a Babbler (*Crateropus canorus*) in his possession. (See paper on Variation above quoted, *J.A.S.B.* 1902, also Bateson, *Materials for the Study of Variation*, p. 43, foot note 2).

Pallid specimens are also liable to revert in this way. A male cream-coloured sparrow I recently obtained put out new feathers of a nearly normal colour, and I have seen a skin of the House-Mynah in the same condition. The grey Bengal Bulbul above alluded to, however, has never reverted; its bill and feet are normally black, as were those of the two grey Jackdaws mentioned with it.

The same phenomenon has occurred in the case of melanism. A Bullfinch (*Pyrrhula pyrrhula*) found as a black nestling in an otherwise normal brood, attained on moulting ordinary female plumage (Howard Saunders, *Manual of British Birds*, p. 188, ed. 1889).

It seems to me that such facts as these furnish a simple explanation of the case of those Herons which are white only in youth.

VARIATIONS IN RELATION OF IMMATURE TO ADULT PLUMAGE.

Darwin gives several cases of this on Blyth's authority, and I can add a few myself.

The skin of a young Crow-Pheasant (*Centropus sinensis*) in the Indian Museum (Reg. No. 11265 from Bhowra) already shows in perfection the rich blue-black body and chestnut wings of the adult, instead of the usual barred plumage of immaturity. Birds resembling the adult in everything except in being duller are quite common.

The young of the King-crow (*Dicrurus ater*) and the small Indian Cormorant (*Phalacrocorax javanicus*) are supposed to be mottled with white beneath; but all the nestlings I have seen in Calcutta have been black like adults. Yet the *Dicrurus* does undoubtedly have a white-spotted immature plumage, and some young Cormorants I reared afterwards *moulted out* mottled below, so that apparently a reversion may take place at the moult.

Similarly, the young Pied Hornbills (*Anthracoceros albirostris*) frequently sold here are always coloured like the adult; but one I knew of moulted out in confinement with white tips and bars to the feathers; a white-barred feathering being given as the young plumage of the closely-allied *A. coronatus* by Parker (Blanford, *F.B.I. Birds*, Vol. III., *p.* 145).

The young of the common Mynah (*Acridotheres tristis*), normally resemble the adult except in being duller, but I have seen two with brown heads instead of black; this is much more common in the young of the allied Bank Mynah (*A. ginginianus*).

The young females of the Golden-backed Woodpecker (*Brachypternus aurantius*), are described as having a black forehead, whereas that of the old bird is spotted with white. Often, however, young hens occur in which the forehead is spotted, sometimes as clearly as an adult's.

D. VARIATION IN PREPOTENCY.

The silver-grey gander mentioned in the note on the variations of the Gray Goose was an example of spontaneous prepotency. Such a variation in the wild state might easily have produced the white and partially white males in the sexually dimorphic species of the genus *Chloëphaga*; *C. hybrida*—the Rock-Goose of Darwin—and *C. magellanica*, the familiar Magellan Goose of waterfowl fanciers, the Upland Goose of the *Origin of Species*, and a third species barely distinct specifically from *C. magellanica*—*C. dispar*, in which the male is barred beneath like the female.

The species *C. rubidiceps*, which is extremely like a small female of *C. magellanica*, may be taken as one in which no variation in the direction of gray-and-white ganders has appeared, or if it did occur, has not been perpetuated by natural or sexual selection.

I have come upon some curious instances of the opposite attribute to prepotency in pigeons. In 1894 I crossed a well-developed and fully-adult Black Fantail Cock with a young and hitherto unmated Homer hen. The Fantail had 33 tail-feathers, the Homer of course only the usual twelve. Yet the pair of mongrel squabs which resulted from their union had only 14 and 15 tail-feathers respectively. I may mention that the Homer hen's subsequent offspring by a cock of her own breed showed no trace of the Fantail; indeed, were telegony better established than it is, so weak a sire could hardly be expected to produce any telegonic phenomena.

A similar case was the failure of the Silver chequer Homer hen, paired to a Blue chequer, to reproduce any offspring of her own colour, either directly or in the second generation, as recorded in *Nature*, June 12th, 1902, *p*. 157.

E. PROGRESSIVE VARIATION.

Cases of a variation carrying on the line of development of a species are probably much commoner than is supposed, the attention of naturalists having hitherto been fixed rather on reversionary types than progressive ones. (*Cf.* Bateson; *Materials for the Study of Variation*, p. 307).

Such a case is the tendency to extension of the green ocellated spots in a skin of a male *Polyplectron bicalcaratum* (Malay Peacock-Pheasant) described by me recently from a skin (unfortunately a poor specimen) in the Indian Museum. (Reg. No. 21344). In this the black speckling on the upper back is in groups of spots in certain feathers, richly glossed with green, forming rudimentary ocelli in a non-ocellated region; and the black patches of the outer webs of the lower tail coverts are green-glossed to some extent, thus approaching ocelli in quite another way. (*Nature*, Vol. LXV., *p*. 367).

Another example is afforded by the Gold-backed Woodpecker (*Brachypternus aurantius*), whose orange-yellow back frequently shows a strong admixture of red, as I have often observed in young birds at all events. (See also Blanford, *F.B.I. Birds*, Vol. III, *p*. 50).

The Bronze-Cap Teal (*Eunetta falcata*), which has of late years been invading India in unusual numbers, was so common last winter 1901-1902 in the Bazaar that I secured no less than a dozen specimens, most of them females. Among these I noticed one with a strong green gloss on the head; one with a tail as purely grey as a male's, and one with a tail as distinctly barred as a female Gadwall's, there being thus two cases of progressive as against one of reversionary variation.

The dull male of the Gadwall (*Chaulelasmus streperus*) closely allied to this species, sometimes shows a green gloss on the head (see Hume; *Game-birds of India*, Vol. III, *p*. 186): I have never seen this myself, but have seen one with a plum-coloured gloss.

The peculiar Teal of the Andamans (*Nettium albigulare*) is now frequently white all over the face, whereas in Hume's time it was exceptional for the white eye-ring and white loral patch to join, and nothing is said by Count Salvadori in the *British Museum Catalogue* (Vol. XXVII., *p.* 257) about any extension of the white. The heads of a normal (Reg. No. 18671) and a white-faced (Reg. No. 18671) bird are figured, from a photograph, in Plate IX. The white-faced specimen was one procured as many as twelve years ago, so that the variety existed then; but it is now quite frequent, though not always so white in face as the bird figured; this specimen is a male, as also is the normal bird shown with it.

F. VARIATION DIRECTLY INDUCED BY CONFINEMENT.

This is not nearly so common as currently believed among ornithologists, and most of the variations which do occur among birds kept in captivity are well-known and recorded.

In male birds of the Finch family which have a carmine or pink colour in their plumage, this hue is not stable, but usually disappears after the first moult in a cage, as I have often seen.

In the Linnet (*Acanthis cannabina*) the red on head and breast leaves no trace at all; the same is the case with the Eastern race when kept in India (*A. cannabina fringillirostris*).

The Redpoll (*A. rufescens*) loses the red on the breast and rump entirely; that on the crown changes to greenish-gold.

The Rose-finch (*Carpodacus erythrinus*) changes the general carmine hue of its plumage to dull ochreous yellow.

The Sepoy-finch (*Haematospiza sipahi*) offers a curious case; it is allied to the Rose-finch, but is a brilliant scarlet, not carmine at all; yet a bird which died half through the moult in Calcutta, had changed, where the feathers had come out newly, to bright yellow.

The Bull-finch (*Pyrrhula pyrrhula*) is very liable to become dull in the red colour; and sometimes turns completely black, usually owing to a too free use of hemp-seed. But this may occur without the bird having tasted any, and also in a wild bird (*see above* p. 158).

Melanism is also common in captive Bulbuls; I have seen it in the Bengal Red-vented species (*Molpastes bengalensis*) the white-cheeked (*Otocompsa leucogenys*) and the white-eared (*Molpastes leucotis*) in which last I have seen it combined with albinism in the same individual.

The Gold-finch (*Carduelis carduelis*) kept under unfavourable conditions, is liable to have its red face become dull orange.

The Red Cardinal (*Cardinalis cardinalis*) becomes dull red if not kept out of doors in a good light; this has happened in Calcutta.

The common Troupial (*Icterus vulgaris*) becomes yellow from amber in confinement if the conditions are unfavourable.

The Pekin Robin (*Liothrix luteus*) is apt to fade as to its orange, yellow, and green tones in confinement; it is also liable, in the plains of India at all events, to melanism, becoming either irregularly splashed with jet-black, or regularly washed or clouded with a dark smoky hue, as if it had bathed in ink. Both these variations occurred in two birds out of about a couple of dozen kept under exactly the same conditions in Calcutta. Their companions manifested no dislike to them.

The Rosy Starling (*Pastor roseus*) in confinement in Europe fades to a dirty cream-colour; in India it gets clouded with black, black edgings appearing on the feathers. A bird of mine, deposited at the Calcutta Zoological Gardens, and treated in the same way as about a dozen others, became almost completely black. The bird was in good condition, with the plumage glossy and sleek, and the colour looked quite natural. As these birds are always quarrelling, it was not easy to make out how its companions regarded it.

A pair of Striated Finches (*Uroloncha striata*) kept by a friend of mine in England in an out-door aviary many years ago became during one season heavily mottled with black all over the white belly; but they afterwards reverted to the normal colour.

Conversely, a Black-backed Porphyrio (*Porphyrio calvus*) at present in the Calcutta Zoological Garden has on one occasion moulted out with all the black parts mottled with white; but it has since become, and remained, black again.

A male Red Dove (*Turtur tranquebaricus*) in the same garden, living under the same conditions as many others of the same species and sex, became nearly all white over the normally vinous red part of the plumage.

One of many specimens of *Turtur damarensis* brought by me to the London Zoological Garden in 1892, had last year (1901) when I saw them become very largely white in big patches.*

The male Golden Oriole (*Oriolus galbula*) of Europe, according to Bechstein, never retains its full yellow hue in confinement, but reverts to the streaky green plumage of the female.

The red summer plumage of the barred-tailed Godwit (*Limosa lapponica*) is not always assumed in confinement, for of a pair in the London Zoological Gardens last year (1901) the male was in red colour, but the female showed no sign of it.

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* By some accident these birds have never been registered in the Zoological Society's list, but I am quite certain about the species; I took specimens of the live Pigeons I brought home, to Count T. Salvadori who kindly identified them, being then at work on the group for the British Museum Catalogue of Birds.

Similarly, the adult female Scarlet Ibises (*Eudocimus ruber*) in the Calcutta Zoological Gardens always remain of a rich salmon-pink, while the male shows stains of scarlet in places in the spring.

A young female bred in these gardens moulted out white feathers at first from her brown immature dress, whereas a young male's first adult plumage came out pink.

Some of the hens kept in Calcutta, on the other hand, assume in the breeding season a goitre-like enlargement of the throat; this never occurs in the cock. The fact that the species here remains red at all is noteworthy, as in Europe it becomes very pale, getting more so at each moult, whereas our adult birds here have remained equally bright for years.

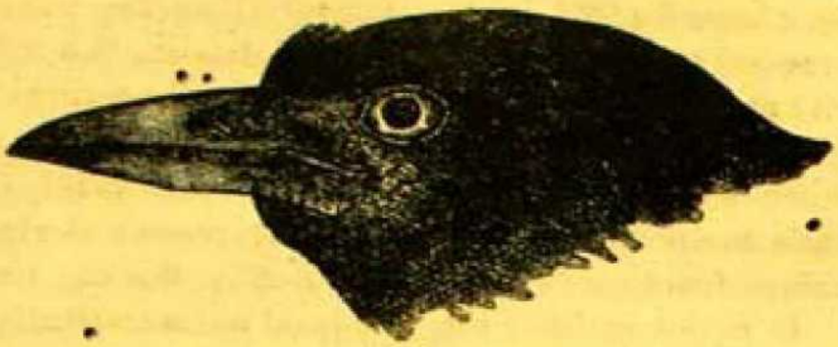
The legs of Finches which in the wild state are black, become usually fleshy white after moulting in confinement, as is well known to fanciers in the common Goldfinch (*Carduelis carduelis*). I find the same thing happens with the Himalayan Goldfinch (*C. caniceps*) when kept in Calcutta, also with the Eastern race of the Linnet (*Acanthis linaria fringillirostris*). The toes are first affected.

G. PATHOLOGICAL VARIATION.

In the cases above-mentioned, the birds seem to be healthy, but when a bird is in poor health, certain variations present themselves which are more or less constant and definable. They may occur under domestication or in the wild state, but are naturally more frequently observed in the former case, since a sickly bird cannot survive long in nature.

Baldness in certain places is very common; the lores, and in bad cases the whole space round the eye, are apt to become bald in the domestic Duck and its ancestor the Mallard, in unhealthy surroundings, as when confined in a coop. The nearly allied Spotted-bill (*Anas pœcilorhyncha*) does not suffer in this way, nor does any other Duck so far as I know.

Baldness round the eyes also occurs in the Starling (*Sturnus vulgaris*) and sometimes in the Rosy Starling (*Pastor roseus*). In the latter species I have seen one or two birds affected while the rest, treated in exactly the same way, were exempt. The head of a tamed specimen of the Jungle Mynah (*Æthiopsar fuscus*), which has become bald-faced while living at perfect liberty, is figured below. The resemblance to the normal state of affairs in the adult Rook (*Corvus frugilegus*), is obvious, and suggests a hereditary incapacity to retain the facial plumage in that species.



HEAD OF JUNGLE MYNAH, ABNORMALLY BARE IN FACE.

The rump becomes bald in many birds, and the tail-coverts and lesser wing-coverts drop out.

Baldness over the whole head frequently occurs in caged birds; and I have seen it in a wild House Mynah (*Acridotheres tristis*) more than once. In this case the whole bare skin of the head was bright yellow like the skin round the eye, which is normally bare in this species.

In caged House-Mynahs in England (but not in India) I have seen this circum-ocular skin faded to white, while the bill and feet remained yellow. The white facial skin characterizes the *young* bird naturally.

A Cassowary (*Casuarius galeatus*) at the London Zoological Gardens last year (1901) showed a large amount of irregular naked skin on the back, which was coloured pink and blue, in faint imitation of the hues of the bare head and neck. In a Cassowary which recently died at the Calcutta Zoological Garden I found to my surprise that the skin on the body was dull white like human skin.

The overgrowth of the bill, claws, and scales of the shank is pathological, and is not necessarily due to old age or absence of wear, which cannot affect the scales of the shank. I have seen a Canary become very scaly-legged in its second year, while another, ten years old, had feet and legs as smooth as a bird of the year.

The feathers frequently become more or less reverted, as in frizzled fowls, in wild gallinaceous birds kept entirely under cover; this I have seen in India in several species of Pheasants and Quails. In one case a single hen Pheasant (the species was *Phasianus torquatus*) was affected, while a cock and several other hens, kept under the same conditions, were not.

H. SPONTANEOUS VARIATION UNDER DOMESTICATION.

While Darwin has very fully and completely gone into the question of the extent of the modifications which can be effected by selective breeding, little attention seems to have been paid to the range of spontaneous variation in birds under domestication, the material, in fact, on which breeders have had to work. I shall therefore take a number of domestic or protected species in detail, and discuss the colour-variations to which each appears to be subject without the intervention of selection.

THE CANARY (*Serinus serinus canaria*). Dr. Bowdler Sharpe in *The British Museum Catalogue of Birds*, treats the Wild Canary of the Atlantic islands as an insular form of the European Serinfinch (*Serinus serinus*); it differs from this continental bird in darker colouration and longer tail. It varies much when not bred systematically.

Birds of the wild colour, called green in the fancy, are common; they are often mistaken by people not well-acquainted with Canaries for Mules or hybrids. They are the strongest in constitution. Yellow birds or lutinos are, as is well known, the commonest. They may be either "buff," *i.e.*, pale whitish yellow, or "yellow," which is bright yellow. If "yellow" birds are continually paired, the offspring is scanty in feather.

A pallid form is not rare, in which the plumage is pale brown with slightly darker streaks; this is the "cinnamon" of the fancy. Once I have seen specimens of a *dark* brown form among common singing Canaries in England. These birds, although undoubtedly pure-bred Canaries, showed in one or two instances no trace of green or yellow, being simply warm brown with dark streaks, and looking rather like hen linnets. White canaries have recently been bred. (*Feathered World*, June 13th, 1902, p. 1039.)

I have read of grey forms, but have never seen any such. Pied birds are very common; the marking is commonly asymmetrical. The parts most prone to exhibit dark feathers in light-pied birds are the secondary quills, feathers round the eye, and two outer tail-feathers. Dark-pied birds run to white in the tail. Cinnamons may be pied, but no gradation seems to occur between cinnamon and green.

I have once or twice seen green birds among Chinese specimens with the central part of the quills and tail marked with yellow as in the Greenfinch. A male Green Canary I once knew for several years began to show yellow about the head with advancing age.

The bills and feet of Canaries are horny in the green, and fleshy-white in the light-coloured types. The retention of the dark colour in the legs is noteworthy, considering the evanescence of this in wild-caught captive Finches of other species.

In view of the variability of the tame Canary, the following opposite instances in allied Finches are interesting:—

Mr. G. C. Swailes (*Avicultural Magazine*, Vol. I., 1894-95, *p.* 118) gives his experience with the Twite in confinement (*Acanthis flavirostris*). A pied cock, about half-white, and a pure white hen, being paired, produced five young; the only two reared were both normally coloured.

"This" says Mr. Swailes, "I expected, as I have reared a large number during the past few years from both white, pied, and cinnamon Lesser Red-polls, and have in-bred them, but have never had one vary in the least from the normal colour."

THE JAVA SPARROW (*Munia oryzivora*) of the East-Indian Archipelago has long been domesticated in Japan, and tame and wild specimens are now both commonly kept as cage-birds. It is not a variable bird in its wild state; I have never seen any variation in wild birds of the species, nor has Mr. W. Rutledge in his very large experience.

The tame-bred Japanese birds may either be pure white or pied with the normal colour. The dark colouring in this case is confined to the upper plumage as a rule, but is not very regular. The head is almost always pure white, and the tail also. The bill, feet, and eyelids are normal. Dr. A. G. Butler, who has bred the white variety, found that a young bird he reared was grey above till its first moult; paired with a normally coloured cock (which it did not desert for white ones) it produced two young like its own first plumage, one like a young wild bird, and two intermediate, all in the same brood. (*Foreign Finches in captivity*, p. 262).

Mr. F. Groser, who has also bred both forms in Calcutta, tells me that they kept distinct whenever they could find mates of their own colour.

The tame white birds are larger and stronger than the wild type. They are more phlegmatic, but also more spiteful; the small sexual distinction, in the stouter and larger head and bill of the male, is more marked. The song of the white birds is quite different, according to Dr. Butler.

THE SHARP-TAILED FINCH (*Uroloncha acuticauda*) of Eastern Asia has also long been domesticated in Japan, and its tame forms are the "Bengalee" of English fanciers. Dr. A. G. Butler, who in his *Foreign Finches in Captivity* beautifully figures the three tame varieties, considers with the late J. Abrahams that this little domestic Finch originated in a cross between the Striated Finch (*Uroloncha striata*) and the Indian Silver-bill (*Aidemosyne malabarica*). I cannot agree with this, as my observation of these birds leads me to conclude they are simply derivatives of the Sharp-tailed Finch (*Uroloncha acuticauda*); I have never seen one resembling the Silver-bill or the Striated Finch, and all three species are well known to me in life as well as in the skin. The late Dr. K. Russ, the greatest authority on small birds in captivity, gave *Uroloncha acuticauda* as the ancestor of the domestic bird. Some tame forms resemble the type, but they are generally pied with white, the amount of this colour varying from a few white feathers to complete-whiteness. The pied markings are irregular and unnatural-looking. There is a cinnamon form, showing the markings of the dark-brown type on a fawn-coloured ground. This is generally pied with white, grading, as the dark-pied birds do, into complete whiteness, and pied irregularly like them.

Pure white birds are less common than pied ones, but more so than dark-brown typical or pure cinnamon birds.

There is no intergradation between the brown and cinnamon forms.

The bill and legs vary as in the Canary; they are normally coloured in normal or nearly normal types, fleshy white in cinnamon, white, and light-pied forms The upper chap may be black and the lower fleshy white, in correspondence with the head-marking.

The cinnamon and white forms are smaller than the dark-brown ones.

THE COLLARED DOVE (*Turtur risorius*). The exact origin of the domestic Turtle-dove is unknown; its varieties are of three types The ordinary form is creamy-fawn with drab primaries and white tips to the tail-feathers except the central pair; a half-collar on the nape and the proximal half of all the tail-feathers below are black The bill is black, the iris red, the feet purple-red, and the eyelids creamy-white. The sexes are similar, though the cocks are almost imperceptibly lighter about the head. The young have no distinct collar, have fleshy-coloured bills and paler red feet. This form does not vary more than a wild bird, and English- and Indian-bred specimens are alike.

There is also a white form with a flesh-coloured bill and paler red eyes; the pupil is often red (non-pigmented) in these. This may have a dark collar, but is generally without it.

There is an intermediate form, coloured generally as in the common type, but with the primaries white, collar drab, all tail feathers white but the two central, which are buff, and grey at base of tail below instead of black. The bill in this form is flesh-coloured and the irides light red as in the white birds. I have only seen this in India.

Mr. D. Ezra, to whom I showed birds of this intermediate form tells me he got somewhat similar birds by crossing the white and black-collared fawn types. He is sure they were not pied or splashed as Pigeons often are.

I have seen in cages of these Doves specimens of a drab colour with with dark ring, identical in plumage with the wild *T. douraca* of India, but in the absence of opportunities of studying these individuals I cannot say whether they were tame or wild specimens; I think the latter.

THE ROCK-PIGEON (*Columba livia* and *intermedia*) has been so long bred selectively that it is not a good species on which to study spontaneous variation, since it is hard to find it in a really unselected state. Both the Western and Eastern forms produce chequered individuals when wild.

By studying Pigeons not selected for colour, or living in a semi-feral state, as in towns where they pick up their living in the streets, the following leading types are evident :—

(*a*) As in wild type ; common, but not the most numerous.

(*b*) Silver, a pallid form, greyish cream-colour with the wing-bars and tail-tip dark drab ; bill flesh-colour. Not uncommon. Correct for many breeds.

(*c*) Blue-chequer, with the back and wing-coverts mottled with black ; very common, in fact the most numerous in semi-feral pigeons, and also occurring frequently among birds in a perfectly wild state.

(*d*) Silver-chequer, the corresponding marking in cream and drab.

(*e*) A sandy-red form with grayish white primaries, rump and tail ; very common. Often the wings are chequered with whitish, when the bird is a red chequer.

(*f*) Silver-dun ; a sort of ashy-grey, with dark-reddish-brown neck and wing-bars ; no tail-bar ; very common.

(*g*) Black, of a dull slaty shade, very common.

(*h*) Pure white ; rare.

Intermediate pied and splashed forms are numerous, generally asymmetrical ; the quills and tail are often more or less white, or again may be markedly darker than the body when this is or white. In this case the marking is symmetrical, but ill-defined. Blue and black, blue and blue chequer, and blue chequer and black, grade into each other commonly ; but not, as a rule at all events, any of the blue shades with red or silver ; nor do these last grade into black as a rule.

The beak is fleshy-white in light forms, the feet and eyes remaining normal, except in whites, where the eyes are dark ("bull" of the fancy).

The pigeon certainly shows convincingly what can be done by careful selection of structural variations, for in its feral state it is not by any means a structurally variable bird. In form a lot of feral pigeons are as uniform as most wild birds, and much more so than some species.

THE BUDGERIGAR (*Melopsittacus undulatus*). This little Australian Parrakeet, known in books as the Undulated Grass-Parrakeet, has been exported only during the last half-century, and many are still brought over ; but it is largely bred in captivity.

In domestication the usual colour is the typical one, but three varietal forms occur.

One is a pallid form, of a general greenish-yellow tint with the dark markings faintly indicated; the blue cheek spots are present in full development. I have seen at least five of this form.

Another is a pure lutino, clear uniform yellow throughout, with pink eyes. I have seen two of this type.

Two blue specimens, in each case the offspring of yellow birds, have been known. (J. Abrahams, *vide* Mr. R. Phillipps, *Avicultural Magazine*, Vol. VIII., 1902, *p.* 75.)

One or other of the first two is being fixed by breeders, but I cannot say to which form the "Yellow Budgerigars" so often advertised belong. I have seen no pied, splashed, or otherwise intermediate forms.

THE BLUE MOUNTAIN LORIKEET (*Trichoglossus swainsoni*) was bred yearly for about four years previous to 1890, at the Blackpool Aquarium and Menagerie, according to Mr. W. Osbaldeston (*Avicultural Magazine*, Vol. VIII., *p.* 167, 1902). Mr. Osbaldeston, after giving an account of the conditions under which the birds were kept, says "One year a very curious, handsome, 'sportively' plumaged bird was reared. The head was red with lacings of white, and the shoulders were tinted with green. The greater portions of all other parts of wings, body, and tail were of a bright chrome yellow, intermixed with green feathers here and there; and the tail feathers were tipped with red; making a really handsome, showy, and rare bird. It was a young bird in May 1891, and was alive some three years afterwads to my knowledge. I went many times to look at and admire this rare-feathered Lorikeet. . . On one occasion, I noticed that its claws had grown very long. It was always kept in the same cage with the others."

THE PHEASANT (*Phasianus colchicus*) has been more or less artificially cared for ever since the time of the Romans, and so may be fairly reckoned a protected bird. Its variations fall into two main types:—

The pallid "Bohemian" form, in which the cock's ground-colour is a lustreless buff, with the usual dark edgings to the feathers and dark neck almost devoid of gloss. I can find no account of the hen.

The white form, which is found in both sexes.

Intermediates between Bohemian and normal seem not to occur. White-pied birds are common; the white marking is irregular and mostly confined to the upper surface. Pied birds will produce their like if paired, and will give some pied offspring with normal birds; but a white and a normal bird will not usually produce pieds, though some whites may be bred from such a mating. (Tegetmeier, *Pheasants for Coverts and Aviaries*, 3rd edition, 1897, *p.* 150).

White specimens are weaker than normal.

THE GOLDEN PHEASANT (*Chrysolophus pictus*) of China has been bred in confinement over a century.

It is generally true to the type, but a variety, the Black-throated Gold Pheasant, is known (*C. pictus obscurus* of Schlegel) in which the cock's cheeks and throat are dark brown instead of buff, and the scapulars blackish instead of bright red, while all the tail-feathers are barred, the central ones with the rest. The hen of this form is darker than that of the type, as also are the chicks. It is believed to be a variation which has arisen in captivity, as it is only known in that state.

As the Amherst Pheasant (*C. amherstiæ*) the only near relative of the Golden species, has a dark throat and barred central tail-feathers, the peculiarities of this form seem to be more probably due to a reversion to the ancestral type of the genus than to an approach to melanism.

Mr. P. Castang, the well-known wild-fowl dealer of Leadenhall market, tells me that this variety used to be more common, but was not liked, on account of its dull appearance.

THE SILVER PHEASANT (*Gennaeus nycthemerus*) has given no variations in captivity.

THE FOWL (*Gallus gallus*) is obviously excessively variable in colouration. As I showed some time ago (*Nature*, Jan. 30, 1902, *p.* 297) the characteristic colours of all except the highly specialized pencilled, laced and spangled breeds occur in common Indian Bazaar fowls.

I stated on this occasion that the colouration of rufous with a black tail was not recognized as correct for any breed in hens, but in making this statement I overlooked the Nankeen Bantam breed, in which both sexes are thus coloured. This colouration is perhaps the commonest met with in domestic poultry allowed to interbreed freely.

A few more details may here be added :—

The colour of the legs and feet in unselected fowls varies much, being fleshy-white, blue-grey, black, yellow, or olive-green (" willow " of the fancy). The only intermediate form which occurs is the black-mottled white or yellow accepted for Houdans and Anconas respectively

The ear-lobe, as in the wild bird, varies from red to white ; it may present a combination of the two colours. Creamy-yellow ear-lobes also occur. The ear-lobe is blue in the dark-skinned " Silky " breed.

The bill is dark as in the wild bird except in birds which have white or yellow legs, in which case the bill is of the same colour, sometimes marked along the ridge with black.

The naked skin of the comb and face, &c., is uniformly red as a rule, whereas the wild-bird's face is flesh-coloured. A dark purple face may occur, as in the Brown-Red Game, which is hence called "gipsy-faced." The whole skin, as is well-known, is dark in the Silky breed, as is also in this case the periosteum of the bones. This breed has white plumage, but usually dark-faced fowls are dark-feathered also. I have never seen a dark-faced *cock* in India except, of course, a "Silky."

The comb in mongrel fowls is usually single; but rose-combs often occur, and pea-combs less commonly. The single comb is always larger than in the Jungle-fowl, and higher and more arched in outline in the cocks. The wattles are also larger, and are developed in the hens, which is not usually the case in the wild bird. Small crests and a muff of feathers on the throat occur in mongrel fowls of both sexes, but not together as a rule. Tame hens are also often spurred, which is rarely the case in the Jungle-fowl, though Blyth obtained such a specimen. The legs and feet are always larger and coarser in tame fowls than in wild, and the tail is carried more erect.

The wattles may be occasionally aborted, and a median dewlap take their place. This tends to be the case in the Indian Aseel or fighting-cock; and in two fighting-cocks of a larger breed, from Saigon, I saw at Mr. Rutledge's establishment some time back, not only were the wattles absent and replaced by a dewlap, but there were no earlobes either. Their combs were small and non-serrated, and as the neck and head were all bare and red, the general appearance strikingly recalled that of a Condor (*Sarcorhamphus gryphus*).

THE PEACOCK (*Pavo cristatus*) varies at times in its wild state in India. Mr. Hume (*Game-birds and Wild-fowl of India*, Vol. I., *p.* 89) records, on Sanderson's authority, two hens of a dirty yellow. Mr. W. Rutledge once received a cock of the colour of a new copper coin, as he described it.

Most tame Peafowl conform to the ordinary wild type.

White specimens are not rare, with fleshy-white bills and feet. Pied specimens are also not uncommon; the colouration, though not quite regular, and unlike a natural marking, follows certain rules, the neck, primary quills and belly being white, and the rest of the plumage coloured.

Most important of all is the Japan or Black-winged form (*Pavo nigripennis* of Sclater) in which the male has all the wing, except the primaries, black, glossed at the edges with blue and green; the primaries are chestnut with clouding of black along the shaft and edge. The thighs are also black in this form, and the train more glossed with copper than in the type. The hen in this variety is white with the upper surface grizzled with black, and longitudinal central black splashes on the rump-feathers; the tail is black, and the primaries chestnut as in the male.

The feet are fleshy-white in both sexes.

The young are all white in the down and first feather, with a pink flush on the wings; but the young cocks soon become dark. The variety has been abundantly shown by Darwin to arise in either sex as a sport from the type in domestication; it seems in one instance to have occurred wild. It is smaller and weaker than typical birds, and not a match for them; yet when they are allowed to interbreed indiscriminately the black-winged form swamps the other. Mr. Castang tells me that black-winged birds will throw back to the type, but generally speaking the variety breeds true.

THE GUINEA-FOWL (*Numida meleagris*), although so recently domesticated, varies a great deal. I have discussed the colour-variations in *Nature* (June 5th, 1902, p. 126). Since then I have seen two or three of a type I had only previously seen in one pied bird, *i.e.*, lavender without spots. I find self-coloured birds of this type have barred primaries like the dark-purplish self-coloured birds.

Mr. L. Wright (*loc. cit. infra*) says that pied birds are the result of crossing white and coloured specimens.

There is also a form with white ground-colour and dark spots, but this I have never seen. (L. Wright's *Illustrated Book of Poultry*, Cassell & Co., 1890, p. 511). In all the forms the white of the lower cheeks invades most of the sides of the head and neck; and in most birds, even the normally coloured ones, the toes and more or less of the shanks are orange yellow. The white of the face also often invades the wattles, and both these and the face may be stained with blue.

The loose naked skin of the throat is much more developed in Indian than in English Guinea-fowls, often forming a dewlap an inch deep, and frequently coloured a bright sky-blue instead of dull purple.

I procured some time ago a normally-coloured male specimen with a pendulous throat-tuft of feathers coloured like the adjacent feathered part of the neck, of a plain purplish-slate.

THE TURKEY (*Meleagris gallopavo*) of Mexico was found domesticated when the Spaniards invaded America, and very soon was kept in Europe. It has not been bred selectively till lately.

The colour-variations in domestication are few and well-defined. The typical bronze form is not very common in Europe; and in India I have only seen it once in seven years' residence. This bird in colour exactly resembled the plate of this species in Elliot's *Monograph of the Phasianidæ*. The commonest type is one in which the bronze part of the plumage is replaced by black, bronze only in certain lights, the brown and white markings being retained.

The pure black form is also not uncommon.

A white form with the body and tail-feathers subterminally barred with black in a very regular manner is not infrequent; the primaries in this are smoky-black on the inner and white on the outer web, not barred as one would expect. Pure white, fawn, and grey varieties occur in Europe, but apparently not in India.

The legs of dark forms of domestic birds are horn-colour, not pink as in the wild bird; in light forms they are pinky-white.

The occurrence of a downy crest in tame Turkeys has been discussed by Darwin; I have never come across an instance.

The tame Turkey shows a distinct increase in the size of the naked head processes and caruneulations as compared with the wild bird; and the tame Turkeys of India, as Blyth long ago remarked, similarly show a marked increase of development of these parts as compared with European domestic specimens.

The feet are also coarser than in the wild bird.

THE MUTE SWAN (*Cygnus olor*) of Central Europe and Asia has been tame for many centuries in Europe, but has practically lived the life of a wild bird, largely shifting for itself, and often, when left unpinioned, reverting to the wild state, so that its exact natural range is doubtful.

The species has continued true to type except for the production of one well-marked variety:—

The Polish Swan (*Cygnus immutabilis* of Yarrell). In this the plumage is white at all ages; and the nestling-down is white. The feet are flesh- or clay-coloured instead of black, and the frontal knob is smaller. Sometimes the cygnets are fawn-coloured in this form.

The variety is known to be propagated truly for at least one generation. It has occurred in a wild or feral condition, and has been bred from the ordinary type both in England and of late years on the continent.

Intermediate forms occur, for the characters are not sufficiently constant to allow of this type ranking as a species, to say nothing of its origin. Those few specimens which I have seen were, however, all readily recognizable and typical. The variation is not recorded to be at all sexually limited.

THE MUSCOVY DUCK (*Cairina moschata*) of Tropical America, was, like the Turkey, found in a domesticated state by the Spaniards, but it also exists wild.

Domestic birds are often nearly true to the wild type, but seldom completely so, as they usually show a few white feathers about the head. The head and upper neck are often grizzled throughout with black and white, ending very definitely, while the rest of the body remains normal.

Pied birds are common, the black being usually mostly restricted to the crest, back, and tail, but the marking is not very regular. The primaries are always white in pied birds. A variety with white body and black crest occurs, and has been fixed as the "Peruvian" breed.

A slate-grey variety occurs, but is rare.

Pure black and pure white specimens are not uncommon.

The bill and feet in the latter are pale sickly yellow, and the irides light blue, instead of the usual orange-brown.

The bill and feet remain normal in most birds, but the terminal portion of the toes and webs are often pale yellow in pied birds, the rest of the limb remaining normal. The bare face of the drake varies much in extent and development, being either moderate and smooth, or excessively carunculated. It is sometimes nearly all black instead of red, even in white birds. The duck has the bare face and carunculations like the drake, but on a smaller scale, and the development varies similarly.

The form is often heavy and clumsy, but the birds can generally fly, and often display a strong perching instinct.

THE GREY-LAG GOOSE (*Anser ferus*) of the temperate parts of the Old World is the oldest of all domesticated birds, a white tame variety having been known in the days of Homer. It is unusually variable in the wild state, according to Mr. Hume (*Game Birds of India*, Vol. III., *pp.* 63, 64). I have not noticed the variations he mentions, the comparatively few birds I have seen having been very uniform, but I have several times seen a slight difference of colour which he does not appear to have found, *viz.*, the nail of the bill being horn-coloured instead of white. Mr. J. G. Millais (*Wild-fowler in Scotland*, p. 31) records a white Grey-lag which for four winters frequented the Tay Valley with others of its species—this on the authority of a Mr. C. M. Innes, who ultimately wounded but lost it.

This goose has varied very little in colour, presenting only the following types:—

(*a*) Resembling the wild form; correct for Toulouse breed.

(*b*) Silver-grey; only known as a sport in Toulouse ganders. The case, as reported by a well-known water-fowl breeder, Mr. J. K. Fowler, in Mr. L. Wright's *Illustrated Book of Poultry* (Cassell & Co., 1890), *p.* 559, is so important that it may be given in full:—"Some time ago I bought for a change of blood a fine gander from a celebrated fancier, which differed from my own strain in colour, being of a beautiful *silver-grey* instead of dark like my own, though otherwise the markings were exactly similar. I bred from him that year some splendid stock, which all took after their maternal relatives in colour with one exception, consisting of a gander, which came of exactly the same hue as his sire. Since that time, in each succeeding year, I find one or two—seldom more—come silver-grey; and strange to say, they are always *ganders*, and generally remarkably fine, and superior to their brothers. I have never yet bred a single goose of this lighter shade."

(*c*) Pure white, correct for Embden and Sebastopol breeds.

(*d*) Sandy-coloured; never seen by me. "Sandy-coloured (common) geese are not infrequent in some parts." (Rev. Dr. Goodacre on *The Question of the Identity of Species of the Common Domestic and the Chinese Goose*, *P.Z.S.*, 1879, *p.* 711.)

The bill and feet in all tame birds are usually orange, but still a good many have flesh-coloured feet. The irides are dark except in white or light-pied birds, wherein they are blue.

Pied intermediates are common, ranging from white-quilled birds to the more common type of white body with grey neck and head, patch on back, and one on each flank. Ganders are almost always white in rough-bred geese; seldom grey, and still more seldom pied.

Mr. Hewitt found that in crossing the Embden and Toulouse, for which he preferred females of the latter and a male of the former, that the goslings came "'saddle-backed' in the feather, with the head and upper portion of the neck grey, and a patch of the same colour on the thighs, the whole of the remainder of the plumage being white. Singularly enough, the majority of the young ganders and a fair proportion of the geese thus bred are slightly crested, though this peculiarity is not possessed by either parent." (Cassell's *Illustrated Book of Poultry*, p. 562.) Tame geese are much heavier in build than wild, but can fly.

THE PINK-FOOTED GOOSE (*Anser brachyrhynchus*) produces a variety with the feet and band across the bill orange instead of pink in the wild state (see Sir R. Payne-Gallwey, *Letters to Young Shooters*, *p.* 69, foot-note). The same variation occurs in semi-domestication.

Mr. Cecil Smith, in Mr. H. E. Dresser's *Birds of Europe* (*pp.* 71, 72, published 1878), writes:—

"My original pair were perfectly true Pink-footed Geese, there being no suspicion of orange about the bill or legs and feet of either; the colour on these parts, however, became very pale and faded after the breeding-season, and continued so long into the autumn, but towards the end of autumn it got much brighter, the colour being most intense at the beginning of the breeding-season; it is the same with those of their young which have orange legs and bills. This pair hatched three young in 1872; of these only one reached maturity. The legs and bills of the young were all alike, very dark olive-green, showing no trace of pink as long as they were in the down; but soon after they began to assume their feathers the colour on the legs and bills began to disclose itself, and those parts in the only survivor of this brood were and still are orange. Since then the old ones have bred every year, some of the young having orange legs and bills, and some pink like their parents. This year the first orange-legged one, a female, had a brood, some of which had orange and some pink bills and legs. I have never seen any mixture of the colours, the legs and bill being either bright orange or bright pink; there seems to be no gradation between the two. As to the bills, the dark portion (that is, the nail and the base) remains the same whether the other part is orange or pink; in fact, the only part of the bill that shows any change is the part which in the Pink-footed Goose is usually pink."

THE CHINESE GOOSE (*Cygnopsis cygnoides*) of Eastern Asia has long been domesticated in China and has been known as a tame bird in Europe for more than a century.

This Goose as usually seen in England shows two varieties. One in which the colour of the wild type is preserved throughout, and a pure white type, with bill as well as feet orange. I do not remember seeing intermediate pied forms, which no doubt occur.

The bill is shorter than in the wild type, and at the base there is a fleshy knob, level with the forehead above, and noticeably better-developed in the male. The form is of course heavier than would be the case in a wild bird.

The species can be modified to a greater extent, for the large Swatow breed, while typical in colour, has a very large knob, a pendulous feathered dewlap and abdominal fold.

A smaller lighter breed is imported to India from China, inferior in size to the type and much darker and greyer in colour, with the feet as well as the bill black, only just tinged with orange. There is no gular or abdominal flap, but the frontal knob is well developed, and the beak short.

The geese kept in India were considered by Blyth to be hybrids between the Chinese and the common goose, but so far as I have seen they show, in colour at all events, no trace of the latter. Their colour is not very often completely normal, as they frequently show some orange at the base of the beak, a white band of feathers round the base of the upper mandible, and a more or less perfect white belt across the breast. White birds are as described above. Pied birds are common, and usually have the dark colour on the back, flanks, and head. They are just as often ganders as geese, so that white is not sexually limited in this race.

The nasal knob is never very large, and grades into complete absence. Two young specimens imported direct from China, and normally coloured, had each a small round tuft at the back of the head.

The MALLARD (*Anas boschas*) of the Northern Hemisphere has been domesticated since the beginning of the Christian era, and has given rise to several distinct breeds. It varies to some extent when wild, and a great deal in an unselected condition, as when kept in India; the varieties are best considered separately as to sex.

The leading variations in drakes are as follows:—

(*a*) As in wild type; rare; correct for Rouen breed.

(*b*) As above, but no bay breast or white collar, the pencilled-grey of the under-surface running up to the green neck; common; said to supervene with old age in domesticated birds of recent wild stock.

(*c*) As in wild type, but bay of breast running cloudily along flanks; common.

(*d*) Black with a white patch on breast.

(*e*) Blue grey but with the usual markings; breast warm brown.

(*f*) Pure white; correct for Aylesbury, White Call, and Pekin breeds, the last-named being tinged with yellow.

Intermediate types are very common, generally irregularly marked; the breast is the first part to show abnormal white feathering, then the wings. I have never seen a *pure black* duck among mongrel Indian birds.

One pied type recurs so frequently, in various colours, that it deserves special mention. In this the head, breast and shoulders, and hinder part of body are coloured, the rest white. This is the correct marking for the new Indian Runner breed, in which the coloured part of the plumage must be fawn in tint.

As in the fowl, the female varies more than the male:—

(*a*) As in wild type; rare.

(*b*) As above, but light and dark head-markings obsolete, all head being uniformly speckled; speculum often whitish or brown like rest of wing.

(*c*) As in wild type, but lighter; throat and eyebrows white, belly shading into white; speculum normal; common.

(*d*) As in wild type, but ground-colour much darker, rich warm brown, correct for female of Rouen breed; common.

(*e*) Black with white patch on breast; speculum often whitish; common.

(*f*) Blue-grey, often with dark edgings to the feather; not uncommon.

(*g*) Pure white; correct for Aylesbury and other white breeds.

(*h*) White, with coloured speculum and some dark colour on rest of wings. Drakes are never marked like this.

The intermediate types are very numerous; the markings in pied ducks are the same as in pied drakes, which is remarkable when the great natural difference between the sexes is considered. For instance, the type with white neck, wings, and belly, and coloured head, breast and stern, corresponds closely with the drake so marked, and is correct for the female of Indian Runners.

The colour of the bill varies much; the iris, however, is not noticeably variable, being always dark as in the wild form. The legs and feet are always orange except in black and dark black-pied birds, where they are black or black with orange toes respectively; I have also seen some light brown types with dark olive feet, in females. The female's beak is extremely variable, usually a mixture of orange and black in varying proportions; but it may be black-and-slate in the darker and some of the lighter types. In white birds it is generally orange, but should be fleshy white in the Aylesbury, a colour not seen in Indian mongrels.

The drake's bill varies much as the duck's, being most commonly yellow or orange, often pied with black at the ridge and base. I never saw dark olive legs in a drake; except in black or black-pied birds they are always orange. The legs and general form are always coarse.

The OSTRICH (*Struthio camelus*) has been domesticated for thirty years in Cape Colony (Mr. C. Schreiner, *Zoologist*, 4th series, Vol. I., 1897, *pp.* 99, 100).

An abrupt variation occurs in the colour of the naked skin, which is fleshy in some individuals, and grey of a dark or light shade in others. This difference of skin colouration is the main point relied upon to distinguish the various wild races now ranked as species. The plumage of the cocks varies from jet-black to rusty brown, the latter hue predominating in the moister coast districts. They may be more or less spotted with white, and in some the body feathers are curled. The hens vary from dark rich brown to light brown, grey, or ash; they may have wing and tail-plumes white, or be barred with white; and a male-plumaged specimen was in Mr. Schreiner's possession.

I. MORAL VARIABILITY.

Variation in disposition is very familiar to bird fanciers, and as examples I may perhaps be allowed to detail some observations I made recently on two members of the Babbler group (*Timeliidae* or *Crateropodidae*) the Red-billed Liothrix (*Liothrix luteus*) and the striated Reed-Babbler (*Argya earlii*).

I had a couple of dozen of the former and one of the latter in a large cage together. Before the Babbler had been many days in the cage I began to notice the Liothrix often tickling and scratching its head, as they habitually do to each other, but the recipient of this kind attention did not try to return it.

After a little time I introduced eight more Reed-Babblers into the cage, six adults and two young birds. They fraternized with each other and the other member of their species, but before long I had to remove one bird, a young one, for bullying the Liothrix. Twice I caught it holding a Liothrix by the nape and keeping it suspended in the air as it perched, in one case the victim losing many of its feathers on escaping. It also drove the Liothrix from the food in sheer wantonness, whereas the other Babblers displayed no such selfish spirit. The bird was amicable enough with members of its own species. The Liothrix bore no grudge against these for the bad behaviour of their compatriot, for after its removal I saw one of them caressing one of the remaining Reed-Babblers in the usual way. But I never saw these take any trouble to return the compliment, any more than did the solitary individual. However, I did not long keep them in the company of smaller birds.

The Liothrix itself varies in temperament, although usually to be described as tame though nervous, harmless and good-natured; of the two dozen birds alluded to, one, a fine male with a large stout bill and somewhat clouded with black below (*A*) was inquisitive, always coming near me when I approach the cage; but he would not usually take food from my fingers. He was fonder of seed than any of the rest, and was not mischievous, though well able to hold his own. The others did not dislike him on account of his colour variation, unsightly as it was. Very likely his fondness for seed was responsible for the change.

Another bird (*B*) also a male, with a very short bill, was tame, would feed from the fingers, and was slightly inclined to be mischievous. When I put in an unfledged Paradise Flycatcher (*Terpsiphone paradisi*), this specimen made several attempts to pull it off the perch by the tail. *B* was not spiteful, but *A*, in spite of his bigger beak, was afraid of him.

A third male (*C*) normally coloured, with largish bill, was very tame, alighted on a food tray while I had it in my hand, and would peck from my fingers. It pecked several times at the head of the young Flycatcher above alluded to, and also bullied a young Tailorbird (*Orthotomus sutorius*) I put in experimentally. The second bird mentioned made no attempt to molest this little creature, in spite of his inhospitable behaviour towards the Flycatcher a few days previously. Nor did most of the other specimens touch either young bird, so that the interference was unusual in this species. On one occasion I saw *C* mischievously jerking and pulling *B* by the tail, while another was combing *B's* feathers.

Here, then, we have in two species of the same natural group considerable variation in disposition, both individual and specific.

J. VARIATION IN MENTAL POWERS.

It is familiar to bird-fanciers that some individuals of a species learn to speak or sing with greater facility than others.

In talking Hill-Mynahs (*Eulabes intermedia*) and Parrots of various species everyone must have noticed how few specimens can clearly enunciate words. I have only seen two of the above Mynahs which I should call good talkers, and one of these was more perfect than the other.

Sex may be supposed to make some difference, but two out of the only three clearly-speaking Parrots I have known were females; these were a red-and-yellow Macaw (*Ara macao*) and a common Ring-necked Indian Parrakeet (*Palæornis torquatus*). The other was an African grey Parrot (*Psittacus erithacus*) whose sex I do not know.

I also noticed in a brood of young Cormorants (*Phalacrocorax javanicus*) I reared some years ago, that one was so tame that I could carry it about on my hand, while another was so wild and vicious that it was difficult to handle it at all.

Two young Bayas or Weavers (*Ploceus atrigula*) which I recently reared varied exceedingly in intellectual powers. Both were confiding, but one was also nervous and stupid, dashing off in aimless flights, and when coming to me settling sometimes on my nose; while the other's excursions were much more purposeful, and it would freely alight on my head or shoulder, or on those of others, hardly ever trying to settle on the face.

K. VARIATION IN TASTE.

A few instances of special preferences or the reverse in diet seem worth recording.

Mr. Meldrum of this city tells me that a Bhimraj (*Dissemurus paradiseus*) in his possession will not eat cockroaches; the specimens I have kept have usually done so readily, although supplied, as his bird is, with other insects.

I have noted above (p. 179) in one Liothrix (*L. luteus*) out of two dozen kept under the same conditions, a strong appetite for canary-seed. I have heard of a pair which ultimately killed themselves by too much indulgence in this article of food, although they had a choice.

Sexual variations in taste have been fully dealt with by Darwin, and it is plain that individual inclination to breed outside the species frequently occurs. (*Descent of Man*, 2nd edition, 1899, *pp.* 414, 415).

The aversion to particular males, however, often alluded to, is very probably due in many cases to the male in question not being strong enough to coerce a refractory female. Darwin mentions this (*Descent of Man*, second edition, 1899, *p.* 417) with regard to the fowl; and in the case of the Pigeon and Canary, the more frequent occurrence of the phenomenon seems to be connected with the greater equality of the sexes.

I once witnessed a case in which a male domestic collared dove (*Turtur risorius*) confined in a hutch with a recently wild caught Turtle-dove (*T. auritus*) female, bullied the unfortunate bird till she was nearly scalped, with the result that ultimately she laid, although no young were hatched from the eggs.

Had she been the stronger bird, this would certainly not have happened; I have seen a female Muscovy duck repulse ignominiously a male common drake which tried to pair with her.

The converse case, of a cock strongly objecting to a particular hen, has been recently recorded with the fowl by (Bateson, *Royal Society Reports to the Evolution Committee*, I., 1902, *p.* 100).

L. VARIATION IN HABITS.

Some habits of birds, such as the method of showing off to the female, of manipulating food—with or without the use of the feet—seem remarkably constant, but the ordinary way of living is subject to considerable variation. Darwin and Wallace have given a good deal of evidence on this head, and perhaps it will not be considered out of place if a little more be added.

The Pariah-kite of India (*Milvus govinda*), habitually takes cooked vegetable food in default of meat, such as boiled rice, bread, &c.

The White-breasted Kingfisher (*Halcyon smyrnensis*), a bird of varied general feeding-habits, as it takes both fish and land-animals such as earthworms, occasionally practises piracy; one which haunts the tank in the Museum grounds has taken to robbing the Dabchicks (*Podicipes albipennis*) living there of their fish; I have seen it make several attempts, one at least successfully.

The King-crow (*Dicrurus ater*) of India, although usually preying for itself, also practises piracy at times; and though normally insectivorous, it will also attack small birds and fish.

The Indian House-crow (*Corvus splendens*), though usually carrying objects with its beak like Passerine birds generally, may be occasionally seen carrying something in its feet like a bird of prey. As the object is always according to my experience, valueless, a leaf, bit of dry cow-dung, or a stick, it would seem that the prudence of the crow prevents the bird from experimenting on articles of food in this way, lest they be lost.

This crow certainly does learn new habits; those at the Museum are afraid to fish things out of the tank, but down by the Hooghly they take objects off water readily. At the Grand Hotel in Calcutta they have learnt to catch food on the wing, owing to being fed by residents in this way.

Mr. A. L. Butler observed in the Andamans one individual of the Chestnut-headed Bee-eater (*Melittophagus swinhoii*) capturing small beetles while clinging to a bank, while others of the species were hawking insects on the wing in the ordinary way. (*Journ. B.N.H.S.*, Vol. XII., *p.* 561).

I had a common domestic drake which learned to fly up and perch on a seat in company with two Muscovy ducks kept with him. His general power of flight also improved much by his association with these birds, which, as usual with the species, were much more powerful and ready with their wings than common ducks.

Rai R. B. Sanyal Bahadur records that some Wigeons (*Mareca penelope*) and White-eyed Pochards (*Nyroca africana*) kept in an aviary with many other birds learned in this way to fly up to the perches and sit there. (*Hand-book to the Management of Animals in Captivity in Lower Bengal*, p. 309, Calcutta, 1892).*

I observed that some common Teal (*Nettium crecca*) confined in another aviary at the same garden (Calcutta) used to perch on the narrow ridges of nest-boxes. This was also in all probability an acquired habit, as this Teal seems never to perch when wild. No other non-perching ducks in the same aviary acquired the habit, not even the Garganeys (*Querquedula circia*), nor the Wigeons or White-eyed Pochards, though perching ducks were confined with them.

CONCLUSIONS.

In most of this paper I have merely tried to record some facts which may be useful to students of variation, but with regard to the facts concerning the range of variation in domesticated birds given in Section H. (p. 164), the following conclusions seem justifiable :—

Domestication seems not to induce variation directly; it merely gives varietal individuals a better chance of surviving and multiplying, and of producing secondary varieties by crossing with each other or with the type. The frequent occurrence of varieties in the wild state shows that the tendency to produce them is there just as strongly.

Were domestication to act in inducing variability by the change of conditions, we should expect to find our protected species varying more in proportion as they were more unnaturally treated. But this is not the case; the Java Sparrow and Collared Dove, bred for generations in small cages, do not vary more than wild birds; whereas the Pheasant, which lives almost a completely natural life, is more variable than these.

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* The writer includes the Mandarin Duck (*A. galericulata*) as one of the species that acquired the perching habit; but this bird is naturally a percher.

Climate does not *directly* induce colour-variation. The same colours constantly recur in domestic birds in Europe and in India, without variation in intensity. But some types of colouration may be absent altogether in one or the other country. Here an *indirect* action of climate, weeding out colours which are correlated with an unsuitable constitution, may be reasonably suspected.

For so soon as a correlation between colour and some constitutional quality is detected, it will probably be found that selection steps in even in domesticated birds not bred for colour. Fighting cocks are very variable in colour, being judged solely by courage and prowess in the pit, and hence not selected deliberately for colour-points. Yet the quasi-natural selection to which they are exposed seems to act in suppressing some few colours; cuckoo-coloured (barred-grey) birds—so common among unselected fowls—were rare in English fighting game, and I have never seen a cuckoo-coloured Aseel or Indian game-cock. In this breed, which is even more courageous than the English game, and has to fight under more trying conditions, the range of colour is altogether more limited than among English birds; the hen, for instance, is never of the wild "partridge" colour, and very rarely shows any approach to it, though the cock usually has some likeness to the male of *Gallus gallus*, the Red-Jungle Cock, his ancestor.

On the other hand, the duck, domesticated in so unnatural a climate as that of India, shows much the same variations as it does in England.

Every species we have taken under our protection varies in its own way; the two tame geese, Grey and Chinese, so nearly allied that they produce a fertile hybrid, have not an identical range of variation.

The variations of domestic birds have mostly an abnormal and unnatural appearance, like casual variations among wild forms; this may in some cases be explained. For instance, most domestic species produce a white variety, and albinoes are common among wild birds; yet these are usually unfitted for the struggle for existence on account of their colour, and accordingly we find few white *species*. Those we do find may reasonably be supposed to have originated as albinistic sports; in the family where white species are commonest—the Herons—we still find yet other species which commonly produce temporary or permanent albinoes. A bird with the primary quills only white at once looks unnatural, and yet it is an extremely common variation among both tame and wild birds. Examination of the white quills, either in pied or pure white varieties, will very commonly show them soft and abraded at the tips, a serious matter for a wild bird. Accordingly we find that white-quilled *species*, like white ones, are almost always large and strong, and well able to defend themselves.

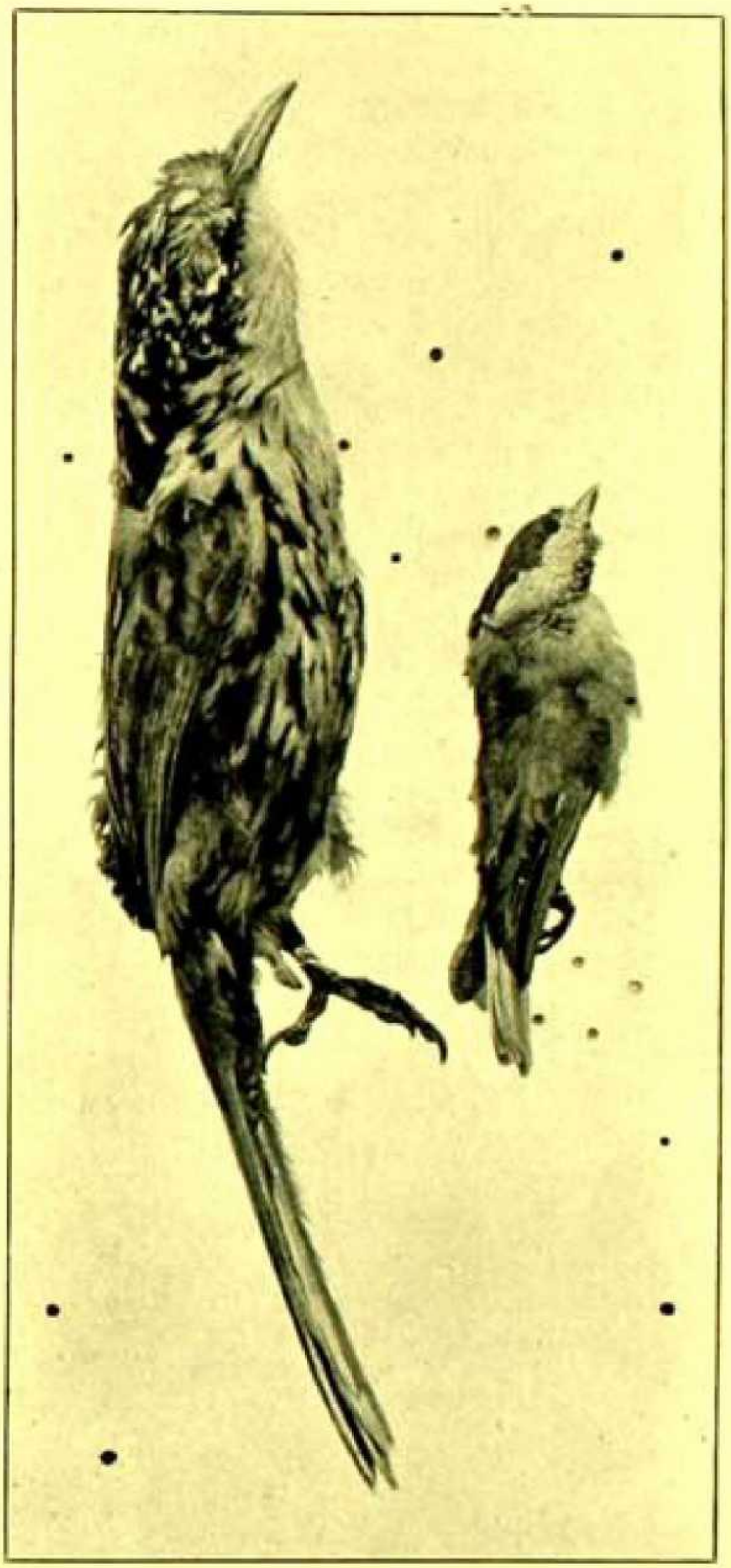
Why no *species* is mottled or splashed or irregularly pied, as tame forms and varieties commonly are, is less easy to understand. But the fact that constitutional disturbance seems to cause a bird to become temporarily so marked, may afford a clue. Such birds may be weak in constitution, and unfitted to live in a wild state. The hens do not appear to object to them, witness the case given by Darwin of Sir R. Heron's pied Peacock, and that of the pied Black bird recorded by Mr. Bucknill in his *Birds of Surrey*. This latter was evidently weakly; his whiteness increased with age, and he died from natural causes.

At the same time, some species seem incapable of producing mottled or irregularly pied varieties; I have never seen such in the Turkey or Collared Dove, and the Guinea-fowl is never mottled or splashed, although its pied markings are not quite as regular as a wild bird's. The Canary, on the other hand, is particularly prone to be asymmetrical and irregular in its markings, as also is the Pigeon.

The tendency of so many domestic birds to become coarse and heavy-looking, especially marked in the Water-fowl, is probably due to the adding up of small variations in that direction; these would, especially on birds performing long and perilous migrations, be weeded out in each generation; but if allowed to breed, would, in accordance with a tendency well-known to fanciers, produce offspring coarser and heavier even than themselves, till a conspicuous difference in appearance resulted.

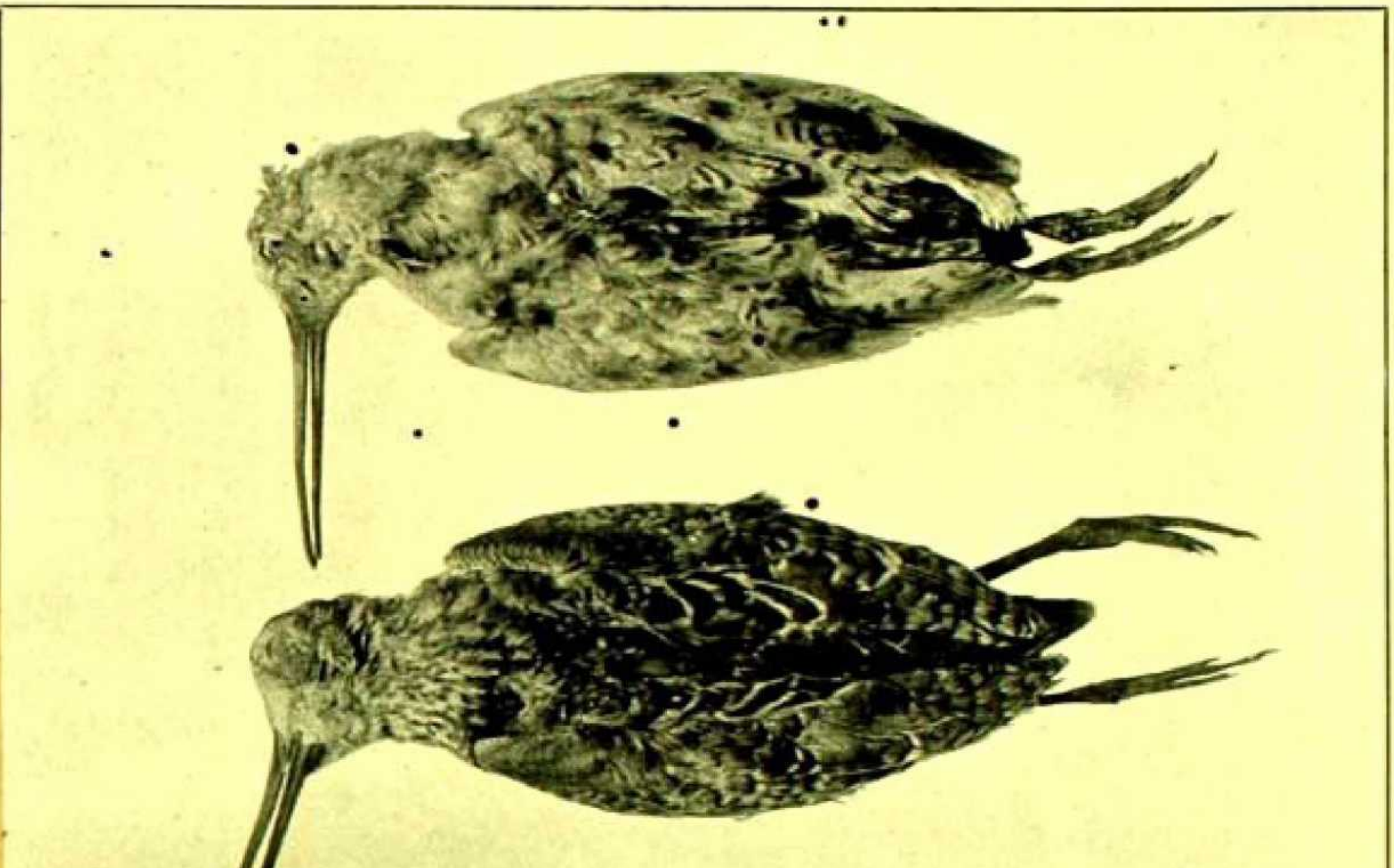
It is possible that the tendency to the increased production of fleshy out-growths, like the combs and wattles of poultry, is connected with this assumption of a coarse habit of body; but it must be remembered that such processes are peculiarly susceptible to external influences and constitutional changes, and, hence, if the environment is ever proved to produce an inherited effect on any bird, might be expected to show this effect early and conspicuously.

PLATE VII.



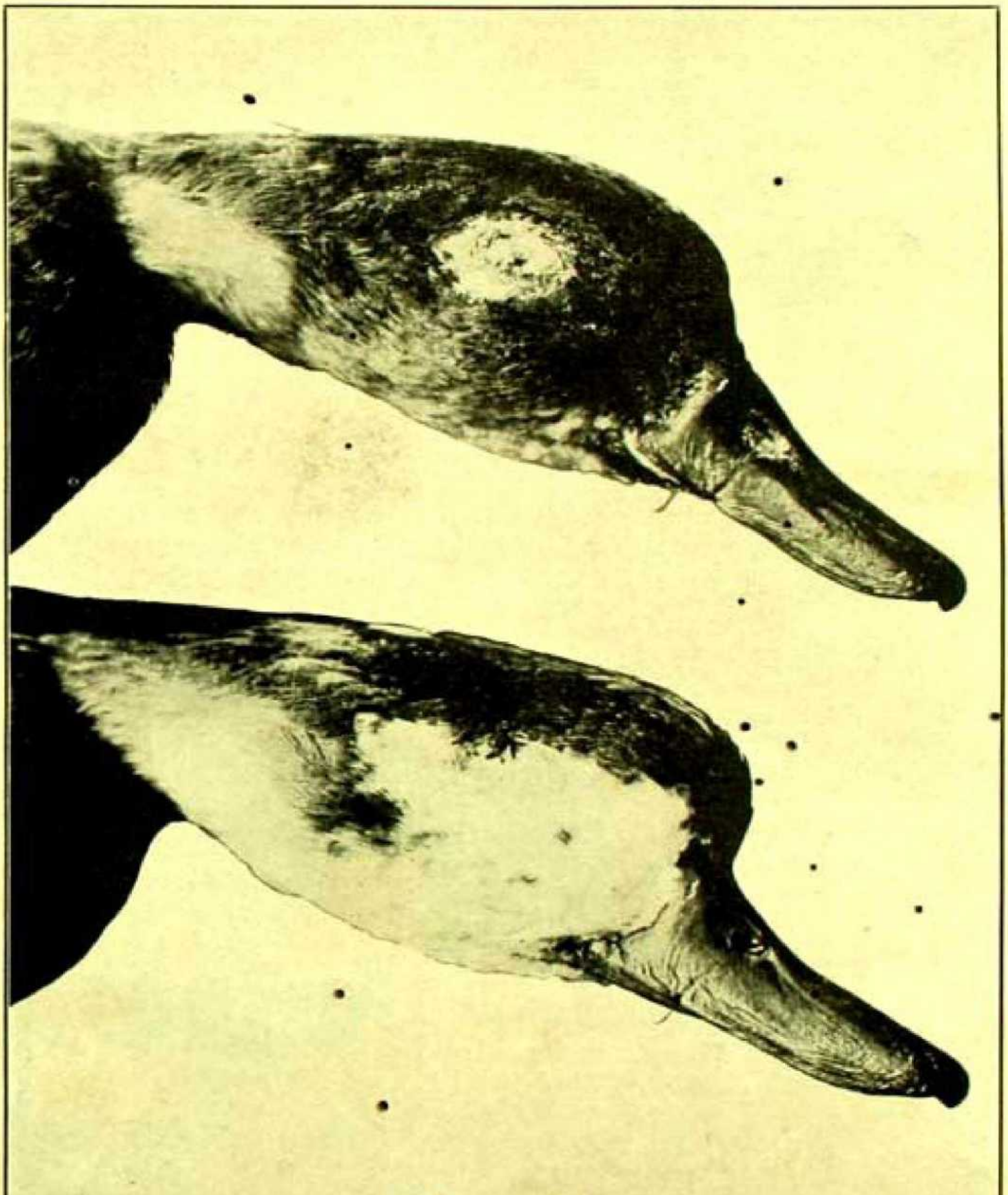
BABAX LANCEOLATUS. PARUS PALUSTRIS.

PLATE VIII.



VARIATIONS OF PINTAIL SNIPE (*Gallinago stenura*).

PLATE IX.



NETTIUM ALBIGULARE.

A. *Normal form.*
B. *White faced variety.*

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